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ENDEMIC GOITRE
OR
THYREOCELE



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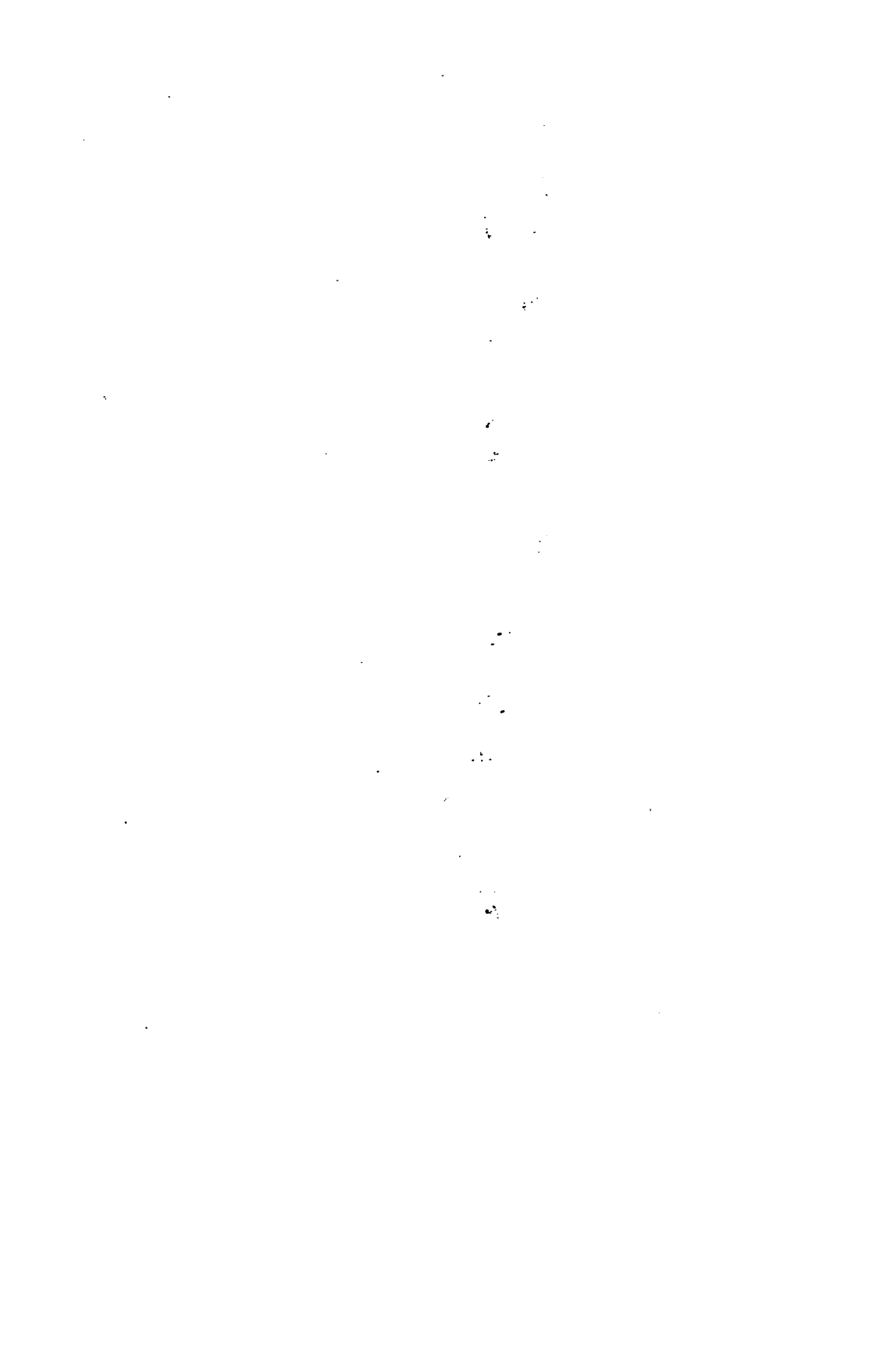
ENDEMIC GOITRE

OR THYREOCELE

(INCLUDING ITS RELATIONS TO CRETINISM AND
ALLIED DISORDERS)

'Who would believe that there were mountaineers
Dew-lapped like bulls, whose throats had hanging at them
Wallets of flesh?'

The Tempest, Act iii. scene 3



ENDEMIC GOITRE
OR
THYREOCELE

BEING

THE THESIS FOR THE DEGREE OF DOCTOR OF MEDICINE
OF THE UNIVERSITY OF DURHAM FOR WHICH THE
GOLD MEDAL OF THE YEAR 1884 WAS AWARDED
TOGETHER WITH SUBSEQUENTLY-ADDED
FOOTNOTES AND APPENDIX

BY

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GOITRE OR THYREOCELE.

GOITRE OR THYREOCELE.¹

Definition.—The Swiss and French have given the name 'goitre' (a supposed corruption of the Latin *guttur*, the throat) to that simple, cystic, fibroid or fibro-cystic enlargement of the thyroid gland, which occurs endemically, is benign in nature, generally increases slowly, and often continues for years; and this affection, so defined, I propose to discuss in the following pages.

Synonyms.—Heister termed this disease *tracheocele*, a term now limited to encysted, air-containing tumours which have developed in the course of the trachea. Following a like terminology, the word *bronchocele* (βρόγχος, the windpipe) has generally been applied to the tumour by the English, but is scarcely appropriate, since the term *bronchus* is limited to each of the two main divisions of the trachea; this name, however, has the advantage of priority of use, since it is not simply derived from the Greek, but was used by the Greek writers in the same sense as at present. *Thyreocele* is, to my mind, a better appellation than *bronchocele*, since it marks precisely the site and one of the chief characters of the affection. The disease is also called in England 'Derbyshire-neck,' from its prevalence in that county; or simply *thick-neck*.² Alibert called it *thyrophraxia*.

To avoid false conclusions as to the results of treatment we must limit the above-named terms to *simple* hypertrophy

¹ Θυρεός, ὄ, a large oblong shield; and κήλη, a swelling.

² *Nithsdale-neck* is a Scottish equivalent of goitre.

of the thyroid, as already defined, and not apply any one of them indiscriminately to all tumours in front of the neck, or at any rate to all enlargements of the thyroid, including cancer. This rule has not been observed even by Professor Kocher.

History.—As already mentioned, the Greeks wrote about the disease, and termed it *bronchocele*. During and after the time of Hippocrates it was attributed to the use of snow-water. Pliny knew of its occurrence in the Alpine valleys, and Celsus speaks of the application of caustic for its removal; but the Arabian physician Albucasis, who lived in the eleventh century, gave the first good account of the affection, and likened it to the flap or dewlap of a turkey-cock. At the close of the fifteenth century, Paracelsus in Switzerland attributed goitre to the mineral impurities found in the drinking-water, and referred especially to the sulphide of iron, or as he termed it, *marchasita*, a view which has been again brought forward by Saint-Lager so recently as 1867. During the seventeenth and eighteenth centuries several works were written on the subject, the chief perhaps being by Prosser ('An Account and Method of Cure of Bronchocele, or Derby-neck, in Coventry,' London, 1769). In the early part of the present century many authors on goitre appeared, including Fodéré, who was himself goitrous, yet maintained that goitre was the first step towards cretinism (Paris); Quadri (Naples); Alibert (Paris, 1817); A. C. Hutchinson ('Medical and Chir. Trans.,' vol. xi. p. 235, &c.); Dr. Coindet (Geneva, 1821); Dr. Straub (Hofwyl, 1821); Manson (Nottingham); McClelland ('Medical Topography of Bengal'); Dr. F. N. Macnamara ('Climate and Topography of Himalayan and sub-Himalayan Districts of British India, with reasons for assigning a malarious origin to goitre and some other diseases'); Dr. J. Saint-Lager ('Études sur les causes du Crétinisme et du Goître endémique,' Paris, 1867); and Baillarger (1873). Some commissions were instituted (including the Sardinian and Lombardian) to investigate the etiology of thyreocèle and cretinism. Since the recognition of myxœdema as a distinct disease many physicians have

been interested in the relationship between this disease and cretinism; the chief names associated with this question at first were the late Dr. Hilton Fagge, Dr. Ord, Mr. Curling, Sir William Gull, Professor Kocher (of Berne), &c. Professor Billroth, of Vienna, has published an account of his results of the surgical treatment of goitres (see 'Clinical Surgery,' by Billroth, translated by the New Sydenham Society).

CLINICAL CHARACTERS OF THE TUMOUR.

Appearance.—The disease occasions a swelling in front of the neck, in the situation of the thyroid gland; it may be a slight general enlargement only, but often it is greater or irregular, one or both lobes or the isthmus being chiefly affected; occasionally the two lobes and isthmus are symmetrically enlarged. The right lobe is generally more affected than the left. Exceptionally an accessory lobe may be present and become hypertrophied. The gland, in rare instances, assumes a gigantic size, weighing as much as 7 or 8 lbs. (Fodéré), reaching to the middle of the chest, being as large as a pumpkin and looking like a pelican's pouch (Alibert). A goitre has been known to reach from ear to ear and press on the meatus auditorius so as to close it up, and Alibert mentions one case in which the swelling was of a tapering cylindrical shape, and reached to the middle of the thigh. On the other hand the growth is often not bigger than a cherry and situated on the isthmus directly over the trachea.

The skin covering the tumour is not discoloured, unless inflammation of the swelling occurs, which is rare, but of which I have seen one example. Should the growth have *suddenly* become very large, the skin may be somewhat transparent and look stretched.

Palpation.—To the hand it is usually soft, but may be firm (in the fibrous variety) or hard (if cartilaginous or calcareous). It is not tender, neither is it the seat of pain

(unless complicated by inflammation). In large cystic thyreoceles more or less fluctuation may be felt.

Unless of very great size the goitre follows the up-and-down movements of the trachea in swallowing, this sign being almost pathognomonic of the affection. Pulsation occasionally may be felt (or seen), which is distensile and eccentric, and synchronous with the cardiac systole, and is evidently due to the vascular character of the tumour itself; or pulsation may be simply communicated from the subjacent carotid artery or an enlarged thyroid vessel. Occasionally the throbbing is very distinct, and *apparently* very superficial (in this case it is usually in the site of one or other superior thyroid artery), though *in reality* the pulsating and enlarged vessel may lie very deeply and be reached with difficulty, should it be decided to apply a ligature. A case of this kind occurred in the Kashmir Hospital, and was reported in the 'Lancet' of March 19, 1881.

Progress.—When the disease has begun, it usually increases, generally slowly, but sometimes very rapidly, so as to give rise to distressing symptoms in six to ten days as I have seen it. It may become stationary or again increase, and that more rapidly; there is, in fact, no uniformity in this respect. It often continues during the whole term of life, though in some cases as age advances it is said to shrink, but in one of my patients, whose age is nearly eighty years, the greatest breadth of the goitre is between 8 and 9 inches and the circumference of the neck $20\frac{1}{2}$ inches. Temporary increase in size of the growth is common, especially on taking 'cold,' or in fact during any temporary illness, or in females at the menstrual epochs, though in this latter case by no means always so. It has been stated that goitrous tumours often increase during summer and diminish during the winter months, but I have often heard patients complain of increase of their thyreocele during cold and wet weather.

Pressure effects.—In the majority of cases no uncomfortable effects result, the disease being simply a deformity; or the only inconvenience may be the weight of the gland if much hypertrophied, or inability to look easily and com-

fortably downwards to any work, *e.g.* sewing, owing to the chin impinging on the thyreocele. Other effects are alterations in the voice, more or less dyspnœa and dysphagia, which symptoms I shall treat of in detail under the effects due to pressure upon the laryngeal nerves, trachea, and œsophagus. Here I may remark that *the pressure effects bear no proportion to the size of the goitre*, as many large thyreoceles give little or no inconvenience, whilst small tumours often give rise to distressing symptoms, or (rarely) even suffocation from pressure upon the trachea and laryngeal nerves. In this particular, hypertrophy of the thyroid is analogous to hypertrophy of the prostate, as the latter also may be greatly enlarged without causing much or any annoyance if the middle lobe be unaffected, whilst a very slight increase of this lobe, irreconisable by digital examination, may produce disastrous consequences. Why are some goitrous persons the subjects of pressure signs, whilst others escape? This difference appears to depend upon (1) the situation of the tumour; (2) its manner of growth, *i.e.* as to whether it bulges internally or externally; (3) the effect of the muscles and cervical fascia in binding down the thyreocele and causing it to press upon the parts beneath; and (4) the rapidity of growth—a rapidly enlarging tumour often gives rise to very distressing symptoms from pressure, as the parts have not had time to accommodate themselves to the new growth. These points will be again spoken of. Of all the pressure effects dyspnœa is the most dangerous.

Pressure on the trachea.—Compression of the trachea, resulting in dyspnœa, may be caused by tumours of all sizes; but in the cases I have treated small thyreoceles have oftener caused this symptom than larger growths. The chief factor in the determination of dyspnœa, however, is the situation of the goitre; if this is seated in the lower part of the gland and spreads downwards so as to push against the manubrium sterni, compression of the windpipe follows, and difficulty of breathing is produced. The same effect I have often seen result from growths not larger than a cherry when placed in the isthmus and covered only by skin and fascia; and it may

occur at the beginning of those cases where the swelling commences in the lobes of the gland, but later on, when the tumour bulges between the fibres of the cervical fascia and by the side of the sterno-mastoid, the breathing again becomes comparatively free (Billroth). As the fascia and muscles are generally more rigid in the male sex, deep-seated goitres more frequently cause dyspnœa in men than in women, because in them the resistance offered to their forward extension is greater; this symptom is also very common in the young, before the tracheal rings have gained much firmness and power of resistance. The trachea may be compressed laterally (so as to project in front with its long diameter antero-posteriorly) as well as from the front, and its calibre is occasionally narrowed to a mere chink, so that it might be closed entirely by a very slight increase in pressure (resulting from additional enlargement of the goitre, inflammation, or external pressure); a case of this severity occurred in the Cumberland Infirmary in March 1882, in which death took place during the administration of chloroform. If the tracheal compression is of long duration, fatty degeneration, softening and atrophy of the cartilages pressed upon, result, and this condition, according to Prof. Ed. Rose,¹ is the cause of the sudden death which occasionally happens in goitrous cases, more especially after thyroidectomy, as the softened windpipe is liable to become tilted during sleep round its own axis, thus causing suffocation. In these cases the mucous membrane is often swollen and thrown into irregular ridges.

¹ *Der Kropftod und die Radicalcur der Kröpfe*. Berlin, 1878. Rose further states that 'this condition of tracheo-malacia may remain latent for years if it develop slowly, and if the patient (instinctively) keep his head steadily in such positions that no crack or tilting-over of the softened windpipe occur, or if the goitre be hard enough to prevent such an occurrence. On the other hand this latent peril might appear suddenly: (1) if the pressure become quickly or instantaneously much augmented (e.g. in cancerous degeneration of the goitre or by external pressure); (2) if the accustomed steady position of the head be suddenly overthrown by force, by a fainting fit, or by the administration of an anæsthetic; (3) if by artificial means, especially by hypodermic injections of iodine, the goitre have become smaller, since the kind of surgical splint, which the goitre might have previously formed for the softened part, might be reduced and become too short for the protection of this part, while the pressure at the same time might be increased.' (Review of Rose's work by Dr. Felix Semon in the *London Medical Record* of August 15, 1878.)

The dyspnœa varies in intensity according to the degree of compression, and is, generally, greater during inspiration than expiration. There may be stridor.¹ The dyspnœa is generally increased on exertion and at night on assuming the dorsal decubitus, and is often paroxysmal. The effects of compression of the trachea I shall now discuss in detail. Owing to the constriction of the windpipe, air does not, during inspiration, enter the chest sufficiently freely; hence the inter-pulmonary air becomes rarefied to a degree proportionate to the compression: this rarefaction would be still greater were it not that the central tendon of the diaphragm is hindered by this condition from descending, and becomes a (more or less) fixed point, so that on inspiration, when the diaphragm contracts, the edges of the ribs are drawn in and the scrobiculus cordis is depressed. This rarefaction of the air within the chest affects (1) the relations of the gases of the blood, and (2) the circulation.

Effect of tracheal compression on (1) the gases of the blood.—(a) *Diminution of oxygen.* As the *oxygen* of the air is not simply absorbed by the blood but enters into a loose chemical combination with the hæmoglobin of the red corpuscles, it does not follow the ordinary law of pressure absorption; hence when the pressure of the inter-pulmonary air is diminished, there is not such a diminution in the taking up of this gas as might have been expected, and besides, in cases of tracheal compression, the tension of the oxygen in the venous blood of the pulmonary artery always keeps below that of the oxygen in the inter-pulmonary air, so that even in the worst cases the last trace of this gas is taken up by the blood and carried by it to the tissues.

(b) *Increase of carbonic acid gas.*—As seen from the above, even should death occur, this is not due to the lack of oxygen,

¹ This stridor 'has never the metallic ring of laryngeal obstruction' (Mac-kenzie). From this fact, and because the energetic excursions of the larynx in the latter affection were also wanting, and in addition the head was not thrown back as in laryngeal dyspnœa, but kept in the ordinary position or bent slightly forward (Gerhardt), I have in a recent case been able to distinguish the dyspnœa of compression from that due to paralysis of the abductors of the vocal cords—a diagnosis I confirmed by laryngoscopic examination. The laryngoscope may be made to demonstrate the inward bulging of the trachea.

but rather to the surcharge of the blood with *carbonic acid gas*, since the exit of the latter from the blood soon becomes impeded when the renovation of the air within the lungs is imperfectly performed.

The first effect of the deficiency of oxygen in the blood is the stimulation of the respiratory centre of the medulla oblongata, giving rise to increased inspiratory efforts, which become laboured and prolonged, and if the compression increase, the blood becomes more and more venous, the inspiratory movements increase both in force and number, all the accessory muscles of inspiration are called into play, and finally almost every muscle of the body which can assist in respiration is involved in the struggle; convulsions, however, rarely if ever occur, as the poisonous narcotic effect of the carbonic dioxide overbalances the effect of the deficiency of oxygen, and because as long as ever any of the latter gas enters the chest it is taken up into the blood. Soon these violent respiratory efforts exhaust the nervous and muscular systems, more especially as the blood, owing to its increasing venous character, lacks its recuperative power; hence there follows a calm, the patient becoming unconscious and appearing to be suffering from a narcotic poison rather than dyspnoea, until, if unrelieved, there is established general paralysis and death. Happily, however, this *rarely* results, though one such case has come under my notice.

(2) **The circulation.**—The rarefaction of the inter-pulmonary air, caused by the tracheal compression, removes from the capillaries of the air cells and bronchial mucous membrane the normal amount of pressure, so that bronchial catarrh and pulmonary œdema soon follow if there is much narrowing of the windpipe, or if the latter have been rapidly produced. This complication must be borne in mind, for I have on several occasions been consulted for bronchitis when it was but a symptom of thyreocèle. Dilatation of the capillaries (pulmonary) by widening the blood-stream tends to stasis of blood, which hinders the easy flow of that fluid through the pulmonary arteries, and so tends to overfill the right ventricle, a condition further increased by the aug-

mented inspiratory efforts causing a greater influx, by suction, of the blood from the large veins into the heart, and so producing (at first) pallor of the skin also. This pallor soon gives place to cyanosis should the engorgement of the right heart persist or increase, owing to the subsequent overloading of the systemic veins, which is also brought about or increased if the *expiratory* efforts require much muscular exertion, as then the flow from the large veins into the heart is impeded; when, if the compression be very severe and increasing, the heart, owing to the engorgement of the right side, and the increasing venous character of the blood, becomes exhausted, the pulse becomes feeble and often intermittent, and in the worst cases finally ceases. [A lesser cause of the feebleness of the pulse may be that the increased inspiratory efforts tend to cause expansion of the aorta, and so to impede the outflow of blood from it into the smaller arteries.]

Pressure upon the recurrent laryngeal nerves.—

The recurrent nerve, from its position by the side of the trachea, between that tube and the gullet, is the nerve most exposed to pressure from a thyrocele. This nerve supplies with motor power the two antagonistic sets of muscles—the *abductors* and *adductors*—of the vocal cords. Experimental physiology teaches us that mechanical stimulation of the whole nerve-trunk results in closure of the glottis—the *adductors* overbalance the *abductors*; hence the explanation of *spasm of the glottis* ensuing from the irritation of this nerve by a goitre. Should, however, the pressure be great or of long duration, paralysis (generally incomplete¹) of the muscles supplied by the nerve results, the affection being bilateral or unilateral, according as both nerves or one only is implicated.

¹ *Complete* paralysis (*i.e.* of both *abductors* and *adductors* of the vocal cords) from simple goitre must be very rare if it ever occurs. There are such cases, however, on record from malignant hypertrophy of the thyroid. In this form of laryngeal paralysis the vocal cords (as may be seen by the laryngoscope) remain *immobile* in the 'cadaveric' position, *i.e.* midway between the median position of phonation and the lateral position of deep inspiration. There is *no* dyspnoea; the voice may be weak or lost, and as the patient cannot adduct his vocal cords when he tries to speak, much of his breath is wasted, so that he requires to make *very* great exertion to throw the cords into vibration. He cannot cough. There may be some amount of stridor on *forced* inspiration.

The following short notes of a case, reported by Dr. Felix Semon to the Pathological Society of London on April 4, 1882, will serve as a good illustration of a thyreocele (although it is possibly of a cancerous nature) giving rise to *incomplete* paralysis of the recurrent nerves,¹ and complicated by direct compression of the trachea :—

An old gentleman consulted Dr. Semon in July, 1881. He had very noisy (and increasingly difficult) inspiration, free expiration, and voice unimpaired—a condition almost pathognomonic, according to Reigel, of *bilateral paralysis of the posterior crico-arytenoid muscles*. The laryngoscope revealed the vocal cords coming completely together on phonation, but not even separating up to the cadaveric position on deep inspiration—thus confirming the above diagnosis. The most careful examination of the neck, thorax, and nerve-centres failed to give any clue as to cause. A serious prognosis was given and tracheotomy advocated if other means of relief failed. This was ultimately resorted to, but with only partial relief, attacks of dyspnoea occurring, and death ensued on the fifth day after operation. *Post mortem*, the thyroid was found to be rather large, but looked at from the front did not present any abnormality. On looking into the larynx, the vocal cords were almost in apposition, due, Dr. Semon supposed, to the loss of tension of the membrana elastica of the larynx in consequence of the long duration of the affection. Both posterior crico-arytenoid muscles had undergone fatty degeneration and atrophy, whilst the striation of the inter-arytenoids and lateral crico-arytenoids (though supplied by the recurrent nerve also) remained intact. Thus there was isolated affection of the abductors, due to the left recurrent nerve being pressed upon by the hindermost part of the left wing of the thyroid, and the right recurrent being firmly embedded into a hard mass, situated on the posterior fourth of the trachea and contiguous with the hindermost part of the right wing of the thyroid. The mass, moreover, pressed from behind and to a small

¹ *Incomplete* paralysis takes the shape of paralysis of the abductor muscles of the vocal cords only or chiefly.

extent laterally upon the uppermost rings of the trachea, softened them completely, and bulged the parts on which it pressed so much inwards that there was a *second tracheal stenosis* by compression, beneath the laryngeal due to the nervous disorder. The nature of the mass was mostly fibroid, with perhaps some cancerous elements in its deep portions. The thoracic organs were healthy; the brain was not examined. Among the interesting points mentioned by Dr. Semon were:—(1) *The double stenosis*. Dr. Semon expressed a strong opinion that the real tumour could not have been felt by palpation during life, and that it was, without doubt, the enlarged thyroid. The second (tracheal) obstruction could not have been diagnosed during life, as the constant approximation of the vocal cords explained the dyspnœa and prevented an inspection (with the laryngoscope) of the lower parts; hence the possibility of a second stenosis in such cases should be borne in mind. (2) *The isolated paralysis of the abductors*, the whole nerve-trunks being affected; this was thought to corroborate Dr. Semon's doctrine, 'that the abductor fibres of the motor nerves of the larynx are more prone to suffer in cases of *organic* disease than the adductor fibres.' ['Lancet' of April 15, 1882.]

In discussing with my friend Mr. John Waldy, senior house-surgeon of the Newcastle-upon-Tyne Infirmary, the reason of the paralysis of the abductors only in the above case, he stated that he remembered a case (at St. George's Hospital) of epithelioma of the œsophagus in which the same symptom was present, and it occurred to us—could the paralysis be of *vascular* origin? Now, the inferior laryngeal artery arises from the inferior thyroid, and runs upwards, with the recurrent nerve, over the back part of the cricoid cartilage, and supplies the muscles at the back of the larynx, *i.e.* the *posterior crico-arytenoids*, chiefly—the *muscles paralysed* in each case; whereas the other muscles of the larynx (including the *inter-arytenoideus*), which were unaffected, are supplied by the superior laryngeal artery, a branch of the superior thyroid, which enters the larynx from above, piercing the thyro-hyoid membrane with the superior laryngeal nerve.

From this arterial distribution we may infer that the fatty degeneration and atrophy of the abductors resulted, wholly or in part, from interference with their blood supply, *i.e.* compression of the two inferior laryngeal arteries; and the non-implication of the other muscles, including the inter-arytenoid, is explained by the non-implication of the superior artery which supplies them. On the right side especially, the inferior artery in Dr. Semon's case from the description could hardly escape. Hence we see that in addition to pressure upon laryngeal nerves we may have to include pressure upon the inferior laryngeal arteries as occasional results of goitre.¹

From Dr. Semon's case the symptoms and laryngoscopic

¹ Since writing the above Dr. Mears, Professor of Anatomy in the University of Durham, has kindly dissected the larynx for me in order to ascertain the exact vascular supply of its muscles. His results fully corroborate my statements. He found the posterior crico-arytenoids to be supplied by the inferior laryngeal artery *alone*; the inter-arytenoid by the terminal twigs of the latter and *by the superior laryngeal*, which also supplied all the adductors and the crico-thyroid, the latter receiving an additional vessel from the crico-thyroid branch of the superior thyroid. Against the *vascular* theory, however, come the following all-important facts:—

1. Should the inferior laryngeal artery be occluded by pressure, collateral circulation would soon be established by the free anastomoses which exist.

2. Dr. Semon has shown that the abductors are not only prone to suffer from paralysis, *either previous to the adductors or exclusively*, in cases of goitre similar to the above, but also when the pressure on the recurrent arises from aneurisms of the aorta, mediastinal growths, or the development of dense connective tissue, enlarged glands, &c. (in which case the laryngeal artery could not possibly be affected), and also from disease or injury of the *trunks or roots* of the vagus and spinal accessory nerve; and this proclivity of the abductors to paralysis is so constant, that he has never seen or been able to find record of 'a *single* case in which primary *organic* disease of the brain or the nerve-trunks was proved, by clinical observation or *post-mortem* examination, to have been the cause of *isolated* paralysis of the abductors.' (See Dr. Semon's paper in the *Archives of Laryngology*, vol. ii., No. 3, July, 1881. New York.) Why the abductors so suffer is not known. It may be that the nerve fibrils supplying them are more superficially located, or that the adductors receive some motor power from the superior laryngeal nerve (as the inter-arytenoid receives some of its fibres), or that it is a local expression of the law that everywhere in the body the abductors and extensors possess less vital resistance and are sooner exhausted than the adductors and flexors. (Ferrier.)

(Dr. Geo. Johnson has advanced the theory that in cases like the one I have quoted the pressure is exerted not on the recurrent but on the vagus, and that the paralysis is brought about by reflex action, the left abductor being paralysed by pressure on the right vagus, and *vice versa*.)

appearances of paralysis of the abductors may be gathered, although this is in itself a very rare affection, yet goitre appears to be its commonest cause (Mackenzie). Should the paralysis be unilateral, the symptoms vary somewhat.

Pressure upon the œsophagus.—This results in dysphagia, a less common symptom than dyspnœa. It may occur from a thyreoele impinging directly upon the gullet, when owing to anatomical reasons (the deviation of the gullet to the left in the neck) it is more likely to accompany hypertrophy of the left lobe; or in those cases in which the goitre develops directly in front of the trachea, the rings of which transmit the pressure. Instances of both classes I have seen; in the latter, the tumours have often been small and cystic. Solids, in these cases, are swallowed with greater difficulty than liquids, the patient, in the more severe cases, having to exercise great care during meals for fear of being choked. Sir Thomas Watson mentions a case of chronic starvation resulting from the pressure of a goitre upon the gullet.

Pressure upon the large blood-vessels.—Occasionally the main cervical vessels are curved outwards by the pressure of a thyreoele. Should the tumour press upon the internal jugular vein so as to obstruct the descent of blood from the head, a turgid condition of the head and face is the result, 'together with headache, giddiness, noises in the ear, and confusion of thought.'

Connection with uterine disorders.—There is not necessarily any connection between menstrual irregularities and goitre, as has been affirmed;¹ the latter often occurs in women perfectly healthy in this respect.

Connection with anæmia.—Neither have I been able to trace any constant connection of goitre with anæmia, and in this my experience is corroborated by that of Dr. Rankine in India. Doubtless some goitrous individuals are, however, anæmic.²

¹ Except in so far as menstrual irregularities may weaken the patient and so diminish her power of resistance to the endemic cause.

² Dr. Holland, by microscopic examination, found in the blood of goitrous

PATHOLOGICAL CHARACTERS OF THE TUMOUR.

Non-endemic congestion of the thyroid.—The first point of departure from the normal condition appears to be due to hyperæmia of the gland—a state of the thyroid (*i.e.* congestion) which may also occur from causes other than endemic, as, for instance, during menstruation, especially when present for the first time, during pregnancy or labour, or flooding in child-bed, or occasionally on any excitement in some weak subjects; but in these cases the enlargement is characterised by its temporary duration, and cannot be spoken of as ‘goitre.’

Simple goitre.—Should, however, the initial hyperæmia be continuous, it leads to exudation into and swelling of its tissue—‘*simple goitre*,’ in which there is merely an exaggeration of the normal structure with increase in its volume. The gland is soft and compressible, appears coarser on section, the vesicles are larger and contain much of their viscid secretion.

Fibrous goitre.—The next phase of the disease is the participation of the fibrous stroma in the hypertrophic process, and as this proceeds, the tumour gradually becomes firmer to the touch—‘*fibrous*’ *goitre*. Often one part of the thyreocoele is soft and another part firm and resistant, pointing apparently to the fact that the change from the simple to the fibrous variety is as yet incomplete. Most frequently this change begins in the centre of the gland and extends outwards, and as the connective tissue increases at the expense of the follicles, tough bands of nucleated fibrous tissue traverse the gland in all directions.

Fibro-cystic goitre.—When this new fibroid tissue begins to contract in parts, many of the vesicles atrophy and become obliterated, whilst others persist, some developing into cysts—*fibro-cystic thyreocoele*. The fibrous variety sometimes does not cause any projection externally; hence it *may* escape

patients a great excess of the pale, and a peculiar alteration of the red, cells. (*Microscopical Journal*, vol. i. p. 176; see also a similar statement in the *Medical Times and Gazette*, vol. i. 1854, p. 430.) *

detection by the hand, and yet it may give rise to pressure signs which are occasionally of a most severe type, especially should contraction of fibrous tissue take place around the trachea, as the dyspnœa caused by this occurrence is most persistent and dangerous from its liability to increase.

Cystic thyroocele: primary cysts.—Cysts may develop in one of two ways. (1) Should the natural viscid contents of one or more vesicles be secreted in an amount greater than that absorbed, the vesicles enlarge to an indefinite extent. In this way each cyst may spring from one vesicle only, or two or more of the latter may coalesce and so form only one cyst. These so-called *primary cysts* are recognised by their smooth lining and by their retaining more or less of the normal epithelium of the original vesicles, though this may degenerate as the cyst increases in size; they collapse also more readily than the second class (to be mentioned presently).

Dr. Baber, in a series of researches on the histology and physiology of the thyroid, an account of which is published in the 'Philosophical Transactions of the Royal Society' for 1876 and 1881,¹ found that a substance, morphologically identical with the 'colloid' of the vesicles, was present in the lymphatics with which the thyroid is so richly endowed, and concluded that these vessels carry into the blood again from the vesicles the colloid material (probably altered in its course), formed in them largely by the destruction of the red blood-cells which have entered them, since these corpuscles are frequently found in the vesicles in all stages of degeneration and decolorisation—in fact in such a state as to show, beyond doubt, that they entered during life. From these researches it seems highly probable that the lymphatics serve as efferent ducts to the secreting vesicles. We may further infer that owing to the initial hyperæmia there arises a derangement of the equilibrium naturally existing between the processes of secretion and absorption that continually go on in the gland—that more fluid is secreted in the cells than can be drained off by the lymphatic vessels; hence the enlargement

¹ See also the tenth edition of *Gray's Anatomy*, p. 717.

of the former and their growth into *cysts*. Possibly also in the fibro-cystic thyreoceles, the development and subsequent contraction of the new fibrous tissue may compress some of the lymphatics, and so offer a mechanical obstruction to the carrying-off by these vessels of the increased secretion of the cells—so that the growth of these latter into cysts is again accounted for.

The *contents* of the cysts vary, but usually consist of dull yellow or brownish viscid fluid, more or less inspissated or fluid. Besides this colloid matter, there may be tablets of cholestrine, fatty matter, and sometimes calcareous particles or crystals—the latter have occasionally been found deposited on or in the lining membrane of the cyst.

The *walls* of the cysts are mostly fibrous, formed in part by increasing fibrous stroma, and in part by the capsule of the gland; this fibrous wall may become cartilaginous more or less, or lime salts may be deposited in it; should either of these conditions occur to any extent, the cyst walls will not collapse after puncture.

When a thyroideal cyst has become very large, it has been known to burst (spontaneously or on receipt of injury) externally, or into the pharynx, &c.

Secondary cysts.—(2) *Secondary cysts* develop by mucoid softening in the swollen parenchymatous tissue, have a rough lining, and their walls possess little elasticity; hence puncture in these cases does not let out much fluid. Their contents vary, but may resemble those of primary cysts. 'More rarely in parenchymatous bronchocoeles it happens the whole substance becomes converted into a greyish granular pulp' (Billroth), which gives during life the impression of being a solid growth. The pulp may be calcified in part. Billroth thinks this form may be diagnosed during life, when on puncture neither blood nor fluid escapes.

Other thyreoceles are 'circumscribed glandular hypertrophies, tuberous adenoma or cysto-adenoma; these may occur singly, but are often multiple' (Billroth).

Vascular thyreocoele.—In another form of goitre, the most marked feature is the dilatation of its blood-vessels,

constituting the so-called *vascular or aneurismatic thyreocele*. In almost all goitres the increase in number and dilatation of its vessels is a prominent feature, so that in some extirpations as many as a hundred ligatures or more have been applied. In the variety under consideration the veins in particular form very dense, capacious, and knotted plexuses, and the whole texture consists apparently of a dense coil of vessels. The substance of the gland has almost entirely lost its granular texture; it is flabby and dark red. After death the tumour collapses considerably. The walls of the arteries and veins are attenuated and friable; and the dilated walls of the vessels contain considerable clots, and capacious cavities are found filled with black, coagulated blood (Hasse). Jones and Sieveking have reported two cases, in which the enlarged vessels were coated with oily matter, together *with destruction of the glandular structure*, traces only of the vesicular epithelium being discovered.

All thyreoceles are encapsuled, the capsule being connected with surrounding parts and the substance of the thyroid by very loose cellular tissue and blood-vessels.

Secondary changes.—Secondary changes, the result of irregular circulation, are common in most encapsuled thyreoceles, blood is often extravasated, portions may break down into a softened colloid mass or become necrosed (yellow infarcts), whilst central cicatrisation is very common (Billroth). Occasionally the blood-vessels passing through the capsule become obliterated, and the contents, thus deprived of nutrition, degenerate into a pulpy, sebaceous matter. Cartilaginous and calcareous deposits often occur, and occasionally to such an extent as to form a distinct shell-like cyst-wall. Rarely, a thyreocele becomes inflamed and may suppurate. The additional swelling caused by the inflammation I have known to cause death by increased pressure upon the trachea. If suppuration takes place in a cyst with calcareous walls, as these do not collapse, a large shell-like cavity may be exposed; such a case, in which the calcareous plate moved up and down during deglutition, was reported by Mr. J. Hutchinson.

The lime deposit has been known to 'melt away' in the discharge.

As great rarities, have secondary growths, resembling hyperplastic thyroid gland tissue in structure, been noted in different parts of the body, such as on the vertex of the skull, in the internal organs, &c., of goitrous patients. One such case was reported by Morris, another by Warrington Howard, and a third by Neumann.

RELATIONS TO CRETINISM AND ALLIED DISORDERS.

No clinical difference between 'endemic' and 'sporadic' cretinism.—Before tracing the connection between cretinism¹ and goitre, I would preface my remarks by the statement that there is no clinical difference between endemic and sporadic cretinism—the sole distinction lies in the frequency or non-frequency of its occurrence.

Goitre and cretinism own the same cause.—Goitre has a close connection with cretinism. Wherever the latter occurs there also is the former found; but there are some goitrous districts in which there are few or no cretins. It is a matter of common observation in some districts of the Alps and Pyrenees, that as the traveller approaches a cretinous locality, he first meets with a zone of country in which few goitres appear; as he proceeds the goitrous become more and more numerous, and some cretins are also found; and, finally, he notices a maximum number of both cretins and goitrous persons (Saussuré and Cerise). From this fact, and because from one-half to two-thirds of all cretins are goitrous, the inference is drawn that goitre and cretinism own the same cause, and that where this cause (*i.e.* the so-called *endemic influence*) is operative in the highest degree, it produces cretinism and goitre, and in those districts where the enemy may be

¹ *Cretinism* is perhaps derived from *creta*, chalk, in allusion to the *chalky* hue of the countenance; or from the German *kreidling* (*kreide*, chalk); or it may be a corruption of *Christianus*, Christian, because of the happy dispositions of these creatures. In old Latin books they are called *Christiani*. (*New Sydenham Society's Lexicon.*)

said to be attenuated goitre only is found, with perhaps a case or two of cretinism (*sporadic*); or, in other words, cretinism is most probably the full development of the morbid state which in its imperfection results in goitre. [*'Le goître est la première étape sur le chemin qui conduit au crétinisme,' Morel. 'La cause qui engendre le goître quand elle est faible, produit aussi le crétinisme lorsqu'elle est plus intense,' Kæstle.*]

That so many cretins should be the subjects of thyreoele in itself forbids the assumption that when they occur together it is mere coincidence, for there are no two other diseases so frequently associated without owning a like cause.

Condition of the thyroid in cretins.—Some few years ago, when sporadic cretinism began to be diagnosed and discussed in this country, in the first five cases, reported by Curling and Hilton Fagge, neither goitre nor even the thyroid gland could be made out by palpation, and this condition was then thought to constitute a distinctive diagnostic mark of this form of cretinism. Later on, the absence (congenital) of the thyroid was found not to obtain in all sporadic cretins; in fact, in one of the first five cases, after death, a small thyreoele was found, in which, during life, the gland was thought to be absent. Later still, cases of sporadic cretinism in England and Scotland have been reported in which there were goitres present. In three cases which I have examined in this district, the thyroid cannot be felt by the hand.¹ French pathologists up to the present have not made any observations *post mortem* on the bodies of cretins, as to the presence or absence of the thyroid, but have contented themselves with reporting the existence or non-existence of thyreoele; in fact, this was all that was kept in view when the French Commission, of which Baillarger gives the report, was instituted (*Enquête sur le Goître et le Crétinisme*). Hence, for anything at present known, the thyroid may be

¹ One of these cases, a cretin of the very *worst* type, aged ten years, died on November 22, 1884. A *post-mortem* examination of the neck only was permitted. No trace of the thyroid gland was found, the supraclavicular tumours were composed of lobules of fat, the swollen and flabby tongue had receded into the mouth, and the myxoedematous condition of the body had disappeared considerably.

absent in some endemic cretins, just as it is known to be in some cases of the sporadic variety. Autopsies in both cases are still a desideratum, and until we have them it is vain to speculate; but, so far as I have been able to ascertain from accounts of reported cases and my own observations, those cretins in whom the thyroid is absent are generally of the lowest type, and have the subcutaneous swellings most marked, and there is no doubt of the truth of Dr. Hilton Fagge's statement, that where the thyroid is congenitally absent sporadic cretinism is always present.

Supraclavicular tumours in cretins.—The presence of the supraclavicular tumours was first noticed and described as met with in cases of sporadic cretinism, yet it seems probable that they may occur in some endemic cretins, although French authors have not mentioned their presence in them, neither have they done so in sporadic cases until quite recently. The Sardinian Commission reported that the non-goitrous cretins 'have the neck fat and thick.' McClelland, in his 'Medical Topography of Bengal,' states that the cervical enlargement of cretins does not always begin in the thyroid, but sometimes with 'a fulness of the base of the neck on one or both sides *above the clavicles*.' As a rule, they are most frequent in young cretins, and become less marked as age increases; in my three cases, they were present in the child of ten years, and absent in the two youths, whose ages are twenty and twenty-seven years respectively.

Why are not all cretins goitrous?—The fact that some cretins are not goitrous has been held to militate against the one-cause theory, but the inadequacy of this objection becomes at once apparent if we look upon cretinism as the result of loss of the physiological function of the thyroid gland (whatever that may be, although it seems probable that it affects considerably the composition of the blood), a condition which may obtain alike in congenital absence, atrophy (as has been found in some cases), or hypertrophic degeneration (to such an extent as to destroy the function of the gland). So far as regards goitrous cretins, we can scarcely speak with decision, however, until autopsies reveal the exact

condition of the thyroid, *i.e.* as to whether there be any normal structure of the gland remaining or not. I opine not. In non-goitrous cretins, on whom *post-mortem* examinations have been made, and which have been 'sporadic' cases, the thyroid has been either congenitally absent, atrophied, or degenerated. Whether Cerise and Baillarger had anticipated any of these conditions or not it is impossible to say, but they do state that the thyroid in cretins (endemic) is developed in proportion to the genitals, and as these in the worst cases remain undeveloped after birth, according to their statement the thyroid must be in a like condition.

Cachexia strumipriva.—The most certain proof, however, that lack of the thyroid gives rise to cretinism is that furnished by Professor Kocher, of Berne, who detailed his results of 'Extirpation of Goitre and its Consequences' to the Twelfth Congress of German surgeons held at Berlin in April, 1883, and communicated to the London Clinical Society on November 23, 1883, by Dr. Semon. Professor Kocher related the condition of thirty-four patients upon whom he had performed partial or complete extirpation of the thyroid gland. In sixteen, upon whom partial ablation had been performed, the results were excellent; the dyspnœa, on account of which the operation was undertaken, was removed, and the general health had suffered in no respect. Of the eighteen from whom he had removed the whole gland, and whom he personally examined some time afterwards, two only showed an undeteriorated or even improved state of health; and in one of these two a small accessory thyroid gland had undergone an hypertrophic change, and in the other a recurrence of the goitre had taken place, thus preventing in each case the development of cretinoid symptoms. The remaining sixteen showed more or less considerable derangement of their general health, the changes being more marked in the oldest cases than in those recently operated upon, pointing to the distinctly progressive character of the change, as to the nature of which Professor Kocher related the following:—A few months after the operation early fatigue, weakness, and sensation of heaviness in the limbs were complained

of. In many cases these were preceded by actual pains in different parts of the body. Soon afterwards a sensation of coldness, especially in the extremities, was superadded. In winter time the hands and legs swelled, became bluish-red and cold, and the patients suffered from chilblains. The mental activity decreased; thought, speech, and movements became slower. At the same time the patients were themselves painfully aware of these facts. Simultaneously with the above symptoms swellings of the face and body made their appearance, which were sometimes at first only transitory, but soon became lasting features; the parts most and earliest affected were, as a rule, the infra-ocular and the eyelids, which showed a somewhat transparent swelling; later on, the nose became thick, the lips coarse, the hands and feet swollen, and the waist stouter; the skin became dry, desquamated a little, was infiltrated, and its elasticity lost; it could only be lifted in thick folds; the hair fell out. The most marked symptom in the progressed cases was anæmia. Examination of the blood showed a relative richness of leucocytes, inasmuch as the number of the red blood-cells was greatly diminished. In the cases in which the patients at the time of operation were young and still growing, the development became most markedly arrested. Rarer symptoms were slight dysphagia, giddiness, and headache. By the ophthalmoscope nothing abnormal was seen, beyond remarkable narrowness of the arteries. Professor Kocher concluded by remarking that the relationship of the above complexity of symptoms to idiocy and cretinism was unmistakeable. For the affection he described he proposed the name of *Cachexia strumipriva* (*struma* in German = goitre). At the time of his making this communication he was unaware of the existence of myxœdema. At the same Congress, Dr. Wolfler stated that Professor Billroth, who had then performed sixty-eight extirpations, had never seen symptoms resembling the cachexia of Kocher, but they operate very exceptionally on young persons in the Vienna Clinic, 'while in older subjects the disease does not appear.' Bardeleben thought the occurrence of these symptoms depended rather on the district from which

the patient came than on the removal of the gland, and supported this opinion by saying that in animals excision of either the spleen or thyroid or both produced no effect on the general health if the animal survived the operation. On the other hand, Bal, of New York, and Reverdin, of Geneva, have observed similar changes to the cachexia after thyroideal ablation. Reverdin even had described them, independently, in the year preceding Kocher's communication (viz. in 1882) in the '*Journal de la Suisse Romande*' (p. 539).¹ When the cachexia strumipriva does occur, it is prone to do so in those under 20 years of age, during the growing period—in Kocher's cases nine were under 20, five between 20 and 30, and only two above 30.

Myxœdema.—I have yet to mention another set of symptoms closely allied to, if not identical with, those of the cachexia strumipriva, and those of the milder forms of cretinism occurring in a disease of adult life, in which the *thyroid body* has generally been found *atrophied or degenerated*. I refer to the '*myxœdema*' of Dr. Ord, or the '*cretinoid state of adult women*' of Sir William Gull. Not one symptom is present in myxœdema which does not occur in the cases of total extirpation of the gland. The arrest of growth of the body in young persons after total ablation presents a symptom, of course, not met with in myxœdema; disparity of age accounts for the difference (Semon).

Baber's researches.—Dr. Baber, from his researches already quoted, says: 'There is, therefore, no doubt that the thyroid exercises some general influence over the composition of the blood. Why a deposit of mucin should take place in the tissues in myxœdema and the cachexia strumipriva is more difficult to explain, but it may be suggested that if the elimination of "colloid" material or its constituents from the blood be prevented by excision or atrophy of the thyroid, a transudation of these substances into the connective tissues generally takes place. This presupposes that on its way back

¹ Prof. Bruns, of Tübingen, has also noted the occurrence of cretinoid symptoms after thyroideal ablation. (See account of Clinical Society's Transactions in *Lancet*, November 1, 1884.)

to the blood through the lymphatics the colloid material becomes changed in character. This is, of course, only theory' ('Lancet'). This theory is feasible, and I would add to myxœdema and the cachexia, cretinism.¹

Why are all goitrous persons not cretins?—Finally, why are all goitrous persons not cretins? Probably because more or less of the thyroid gland retains its proper function—presupposing that the healthy gland is capable of exerting a counteracting influence upon the production of the symptoms common to cretinism, the cachexia of Kocher and myxœdema.

Semi-cretins.—In cases of goitre there are all degrees of intellectual vigour. In goitrous districts many affected persons are observable who exhibit great slowness of speech and movement, and occasionally a swollen appearance of the face and lips, with the skin sometimes of a dull brownish, waxen tint. I have in mind at the present moment a good instance of this class—a man of middle age, whose stolid look, tranquillity of disposition, and slowness of speech remind me most forcibly of cases of myxœdema. I can enumerate at least ten such cases of my own observing, and three of these are almost sufficiently serious to be classed as cretins of the third degree. Probably in these cases, which have passed a

¹ Since this essay was written further confirmation of these statements has been published. Mr. Victor Horsley, in his 'Brown' Lectures (see *Lancet*, January 3, 1885), has detailed the results observed by him in monkeys after extirpation of the thyroid with strict antiseptic precautions. A few days after the thyroidectomy, there began tremors like those of paralysis agitans, followed by paresis and hebetude, oligæmia and leucocytosis; mucin appeared in the blood, in the subcutaneous tissues, which became swollen, jelly-like, and sticky; in the salivary glands, which became enormously hypertrophied owing to the extreme production of mucin; the parotid even secreted this substance; puffiness of the face and eyelids and subnormal temperature, ending in death in five or six weeks. It will be seen that the effects which require in man years for their development appeared in a few weeks in Mr. Horsley's monkeys; nevertheless the likeness of these symptoms to myxœdema and the cachexia of Kocher is evident, and the symptoms following the thyroidectomy justify Mr. Horsley's conclusion that the thyroid is partly glandular (excreting mucin, which accounts for the deposition of the latter in the tissues after ablation) and partly hæmatogenous in function. He further says: 'No doubt vaso-motor or trophic lesions may be the immediate cause of the changes, but even then the functional or actual loss of the thyroid would be the parent cause of the vaso-motor or trophic disorder.'

step or two further than simple goitre on the road to cretinism, little of the thyroid retains its normal structure and function. On the other hand, many goitrous persons possess intellectual faculties on a *par* with or above the ordinary level—in fact, the majority, in this district at least, do not differ from their non-goitrous neighbours in this respect.

Cretins in England.—Yet here I may be allowed to state, from my own observation, that even the worst forms of cretinism may occur occasionally in the goitrous districts of England, without the fact being recognised, as until lately, if there was no prominent thyreocele, the idea of cretinism probably was not entertained. As the subject becomes more universally known, no doubt, some cases of 'idiocy' will turn out to be cretinoid. The first cases of cretinism reported in England were not those by Curling and Fagge, who merely recalled the attention of the profession to this interesting condition. Wood (about the year 1810), in 'Some Remarks on Endemic Idiocy and Goitre,' states that he had seen '19 cretins and a greater number of imbeciles' in Derbyshire; and Read, in 1836, in his 'History of the Cause of Bronchocele,' says that Chiselborough, in Somerset, contained '24 well-defined cretins in its population of 350, nearly all of whom were goitrous. A neighbouring practitioner (Mr. Montgomery, of Blanchland) informs me that he has seen cases of thyreocele accompanied with idiocy in West Allendale, near Alston, and a goitrous family with some idiotic members in Upper Derwent valley. Three cretins, as already mentioned, one of the very worst and the others of the second degree, have come under my notice here. In addition to these three cases, I know of several goitrous idiots or imbeciles, but in them the characteristic features of cretinism are wanting; one of these creatures is deaf and dumb.¹

Variability of endemicity.—That cases of goitre and cretinism vary in number and severity in different affected districts is due most probably to the fact that the cause of

¹ Dr. Savage, of Bethlem, tells me that 'a few cretins existed in Alston' when he was in that district.

the two varies in intensity, just as the cause of malarial fever varies in intensity, this fever not exhibiting the same degree of severity in all malarious districts. That one individual should be goitrous and another cretinoid, although both are exposed to entirely the same influences, is most likely due to some inherent peculiarity in the one, which resists, so to speak, more effectively the attacking cause. Another proof of this variability of the cause may be cited from the fact, that in some badly-stricken localities the individuals display symptoms of the disease at a much earlier age, and it is precisely in such districts that we find the greatest number of cretins as well as thyreoceles.

An interesting, though wholly inexplicable, point is the fact that goitre and myxœdema are most prevalent amongst women, whilst cretinism affects males chiefly. Sir Thomas Watson, most likely quoting Fodéré, states that 'when both parents are goitrous for two generations in succession, the offspring, being in the third generation, are sure to be cretins.'

Goitre and cretinism are different stages of the same affection.—From the foregoing considerations, it is evident that *goitre and cretinism are but different stages of the same affection*; that where the cause acts mildly goitre only is produced, but where it acts with intensity cretinism is the result.¹ Further, it is probable, to a degree almost beyond doubt (reasoning from the striking similarity of the symptoms of myxœdema and the cachexia of Kocher, both of which conditions are characterised by the practical loss of the thyroid gland; and also from the ascertained fact that in some cases, and these of the lowest type, of cretinism, this gland is congenitally absent), that cretinism is primarily due to the loss, functional or real (*i.e.* from goitrous degeneration, atrophy, or congenital absence), of the thyroid gland. Moreover, as the degeneration or atrophy which results in the virtual loss of the thyroid may vary in extent, in this fact probably lies the explanation of the different degrees of intensity of the symptoms of cretinism, or, in other words, the supposition is

¹ Or, we may put it that goitre (when it destroys the *function* of the thyroid) is a *cause* of cretinism.

that cretinism develops *pari passu* as the function of the gland is lost.

How the same cause brings about congenital absence of, on the one hand, and disease or atrophy of the thyroid on the other, is, I must admit, difficult to explain; yet it does not appear impossible that the former result should be brought about in some way or other on the fœtus through the agency of the mother; for it is a well-known fact that, in some districts in the Valais, some of the women who have in a cretinous locality brought forth cretins, when they take the precaution of spending the time of their pregnancy in non-goitrous districts, as they often do, give birth to healthy children, whom they leave to grow up in the latter places in order to escape this hideous deformity of body and mind. The converse of this has also been often observed—viz. that women, who in an unaffected district have had healthy children, have borne cretinous offspring after coming to live in an affected locality.

Virchow's view of the origin of cretinism.—In concluding this part of my subject, I must not omit mention of Virchow's theory of the origin of cretinism, based on *post-mortem* examinations—viz. that it is due to too early and rapid an ossification of the base of the cranium, with consequent arrest of development of the skull and encephalic centres. This premature synostosis, however, is not constant, since it did not take place in Mr. Bowlby's four cases (for an account of which and interesting details of other cases see 'Transactions of the Pathological Society' in the 'Lancet' of Feb. 9, 1884). May this condition not, then, be a secondary result rather than the primary cause of the affection? ¹

¹ It has also been suggested that cretinism is the result of myxœdema occurring in infancy, and due to the swollen subcutaneous tissues padding the peripheral nerves and touch corpuscles, and so the brain, deprived of one main channel of education, and for want of this stimulus, fails in nutrition, and hence the idiocy is said to be produced. Dr. Goodhart (in his paper on 'Sporadic Cretinism and Myxœdema,' in *Medical Times and Gazette*, for May 1, 1880), however, points out the fact that the myxœdema in cretinism is, as a rule, *local* and not *general*, and is consequently inadequate for the production of such a result, and in some cases the swelling of the tissues is but slightly marked. Kocher's view of the development of the cachexia strumipriva is, that a chronic asphyxia leads

ETIOLOGY.

Before discussing the essential cause of thyreoceles, I shall first consider the influence of sex, age, pregnancy, and heredity on its development.

Sex.—In England, goitre affects more women than men. Sir Thomas Watson found an average of three lists to be as 12 to 1. This proportion coincides approximately with my experience, but is by no means a constant one—*e.g.* it was found to be by Manson (1825), in Nottingham, 7 to 1; in Bishopton, near Ripon, 19 to 1 (Paley); at the dispensary of Pontefract, 29 to 1; at that of Chichester, 34 to 1; at that of Ripon, 44 to 1; Ewart, in his 'Notes on the Medical Topography of Alston Moor' (1841, 'Med. and Chir. Review'), says he saw only two cases among men and a great number among women at Alston Moor; whilst Prosser (1769) mentions a small village in Derbyshire where not one man was affected, although 50 females were goitrous. This preponderance of goitrous females over males has been said to be due to the fact that women are greater water-drinkers than men, a statement thought to be supported by the fact that in India men and women are nearly equally affected. In many parts of France and Switzerland the proportion falls to 2 to 1, or even 5 to 4.

Cretinism, on the other hand, is more common among males—a fact totally inexplicable.

Age.—As a rule, the affection does not begin before puberty; very rarely in this country before eight or ten years of age; nevertheless, I have seen it begin in a boy aged one year and a half, in one girl of five and another of six, and in a boy of nine a goitre developed in seven days after he came to this locality.

up to it, as a result of the atrophy and softening of the trachea; but chronic stenosis of the trachea does not give rise to myxœdematous symptoms, and in some cases the trachea and gullet, it is said, may remain healthy.

In Mr. Horsley's monkeys the sympathetic was found *post mortem* to be normal. This argues against Dr. Hadden's view of the myxœdema being due to capillary spasm; moreover, Schiff's experiments on irritation of the sympathetic nerves did not cause myxœdema.

In addition, during the present year I have seen three children born with enlargements of the thyroid, in two of which violent attacks of dyspnœa came on ; of the three mothers, two only had goitre, the three fathers were non-goitrous ; two of the children were females, the third a male. [Dr. R. Bruce Low, of Helmsley, in Yorkshire, in a paper on 'The Etiology of Endemic Goitre,' states that he has not observed goitre in the newly born, but he has seen it at as early an age as eighteen months ; ten of his cases were under five years of age.] On the other hand, it may come on late in life, even when the patient has resided in the same locality during his or her lifetime ; only yesterday (Oct. 1, 1884) such a patient, aged fifty-two years, came to me with a thyreocele of five months' duration. Fallopio (Venice, 1563), Piræus (Paris, 1612), Jordan (Göttingen, 1794), Bach (1855), and others have reported cases of goitre in the newly born. Dr. Betz (in the 'London Journal of Medicine' of 1850) cites several such cases, and thought that atelectasis of the lungs might arise from this cause. Fodéré says many cretins are born with small goitres of the size of a walnut.

Pregnancy.—Many cases begin, as already pointed out, with the first menstruation or with the first pregnancy. In other cases, where the latter occurs, the patient experiences an increase of growth of the thyreocele. Hence we may affirm that this condition favours the development of goitre. Dr. Low points out that the blood of women has a larger proportion of white corpuscles than that of men, and that in pregnancy these are still more numerous ; that the blood-forming organs—one of which is thought to be the thyroid—in pregnancy have more work to do, 'and when the individual lives in a locality where goitre is endemic, if she have hitherto escaped, she develops the swelling so soon as the blood-corpuscle-forming function of the thyroid gland is overworked. With enlargement of the gland there is apparently diminution in the formation of corpuscles—hence, perhaps, the anæmia and other symptoms. . . . This hypothesis of the blood-forming function of the thyroid explains, in some respects, the greater immunity of males from this

disease. The blood of males contains relatively more red cells than that of females. The system of the male is not called upon to undergo the extreme tension and alteration of normal condition which is the lot of the female in menstruation and pregnancy.' Dr. Low further states that in 59 of his 260 cases there was a marked hæmorrhagic diathesis, and that in his district there is a large number of 'flooders' in childbed; but he also states that frequent loss of blood often complicates other diseases besides goitre in his locality. Mr. Lawson Tait, in a paper on 'Enlargement of the Thyroid Body in Pregnancy' ('Edin. Med. Journal,' May, 1875), also says that in the majority of 20 cases he noted a marked tendency to uterine hæmorrhage. Flooding and severe hæmorrhages are far from common in this locality; in fact, I only know of two 'flooders' amongst the whole of my patients, and both are weak, flabby, and anæmic; and this includes an experience of over 300 midwifery cases during the last three years. Post-partum hæmorrhage is in the vast majority of cases *preventible*, and Dr. Low recognises this, yet he says, 'with the greatest care, severe post-partum hæmorrhage does occasionally occur in this district.' It seems, however, probable that this association is accidental.

Heredity.—We have seen that goitre may be *congenital* (*vide* under 'Age'), but from this it does not follow that it is hereditary, since the child *in utero* is exposed to the same causes as the mother. Copland states that 'authors have adduced conclusive proofs of its occurrence hereditarily, independently of endemic influence,' but the only authors I have met with who give such proofs are Crawford and Inglis ('Treatise on English Bronchocele,' London, 1838), the latter of whom relates that goitre became endemic in a locality where some French prisoners, presumably from a goitriferous district of France, had been sent; these men formed *liaisons* with the women of the district, and the female portion of their offspring is said to have been goitrous. Occasionally goitre in affected districts seems more or less limited to certain families, whilst others, who are apparently exposed to the same

¹ Dr. Savage also has observed this to be the case in Alston.

causes only, *e.g.* drinking the same water, escape. This tends to support the view of an hereditary tendency to thyreoceles; but that such a predisposing cause is slight and entirely subordinate to endemic influence is shown by the fact that women who have previously given birth to healthy children, after coming to a cretinous locality give birth to cretins, and by the converse fact (see concluding paragraph of 'Relations to Cretinism'). I have seen a child born with a goitre, neither of whose parents were goitrous; I have also one case of cretinism, both parents of whom are non-goitrous and healthy. Further, many cases are acquired by the offspring of non-goitrous parents, and I have never seen nor heard of a case developing in an unaffected locality in the offspring of goitrous parents, except one reported by Dr. Crawford, and quoted by Sir Thomas Watson. Again, cross-marriages with women from healthy localities in cretinous and goitrous districts do not lessen the liability to the affection (Saint-Lager). It is asserted, however, that goitre appears in some cattle as a result of 'breeding in and in.'

Essential cause.—Saint-Lager, in his most valuable treatise 'Sur les Causes du Crétinisme et du Goître Endémique,' devotes four pages to a mere enumeration of the various theories (which number over forty) advanced by authors as the cause of goitre. This fact, of itself, proves the barrenness of our knowledge of the subject, and is due most probably to the inaccuracy and paucity of observations made by individuals, who, seeing goitre display itself in any district, immediately note down any other seeming peculiarity of the place, and associate the two as cause and effect, without stopping to consider or inquire whether the supposititious cause exists in any other locality where thyreoceles is endemic. As notable exceptions, however, stand out the names of Saint-Lager, McClelland, and one or two others. Into all the theories I cannot go; it will suffice to mention some of the more important.

Various conditions of air.—Each and every condition of the air has been brought forward as causative of goitre—hot, cold, damp, dry, changeable, stagnant, with too little or

too much oxygen, or containing sulphurous vapours, or miasm, palustral and special; paucity of solar light or want of electricity in the atmosphere: all these have had their supporters. That *air does not convey the goitrogenous poison*¹ is evident from the almost universal distribution of the affection. It occurs in high mountains, in low valleys, on plains, in moist and marshy districts, in dry and well-drained localities by the sea-shore (*e.g.* the Isle of Arran), as well as inland, by lakes and rivers, in burning hot countries as well as in the regions of perpetual snow. It has broken out as an epidemic in mid-ocean even (amongst Cook's crew in January, 1772).

A fungus.—Dr. F. N. Macnamara ('Climate and Topography of Himalayan and Sub-Himalayan Districts of British India, with reasons for assigning a malarious origin to goitre and some other diseases'), has recently brought forward the theory that it is due to a poison of a fungoid nature.

Miasm.—Billroth and others believe in the miasmatic theory (the miasm acting through the agency of drinking water).

Multiple causes.—The Sardinian Commission came to the conclusion that the causes were multiple—insalubrity of locality, humidity, absence of sun's rays, lack of ventilation, insufficient nourishment, and poverty. Some have blamed lack of phosphates in the system, owing to mal-assimilation from improper diet. Inebriation at the time of conception, of one or both parents, is said by some to be the cause.

Vaso-motor paresis.—I might mention various other theories, before going on to the consideration of water as the vehicle of the cause, but shall content myself with stating that of Dr. Woakes only ('On the Pathogeny and Treatment of Goitre,' *Lancet*, March 19, 1881). He regards it as due to vaso-motor paresis of the inferior thyroid artery, the result of disease or weakened function of the inferior cervical ganglion. He accepts the view of the thyroid body acting as a diverticulum to the cerebral circulation (in order to prevent too great

¹ *i.e.* that any one or more of the above-named conditions of the air is not the cause.

fulness of the latter), advanced by Dr. C. Parry when writing on exophthalmic goitre—a view exceedingly probable when the situation at the root of the neck and the elasticity of structure of the thyroid is considered. As supporting this theory he points out that the origin of the vertebral artery, which is largely concerned in the intercranial circulation, is close to that of the inferior thyroid artery, and, ‘ which appears of more importance, that both these trunks derive their vaso-motor nerves from the *same* sub-centre, the *inferior cervical ganglion* ;’ so that a vaso-dilator wave, originating from this ganglion, would affect both these vessels, and consequently part of the increased blood supply would be received by the distensile thyroid body, instead of all the increased amount being wafted up into the brain by means of the dilated vertebral artery, and so, he says, an undue congestion of the intercranial contents is prevented. But these two vessels do *not* receive their vaso-motor nerves from the same sub-centre. The inferior thyroid artery receives its nervous supply from the *middle* cervical or *thyroid* ganglion, which rests upon the vessel ; the vertebral artery is supplied by the ganglion he names. So that to apply his theory Dr. Woakes will require to extend the supposed ‘disease or weakened function’ to both ganglia, or to seat it in a higher governing centre. But this is all theory. He thus seems to class simple with exophthalmic goitre, in which he thinks the three cervical ganglia are affected—the difference being one of degree not of kind. He further states that this view disposes of the theory of potable water being the casual agent. I cannot see this ; for may not the goitriferous principle in the water act on the vaso-motor nerves specified in a manner similar to the action of lead on the nerves of the forearm or belladonna on the terminations of the third cranial nerve in the iris ? Dr. Woakes disbelieves in the endemicity of goitre, alleging it difficult to name any district where it is unknown ;¹ doubtless it is much more widely distributed in England even than many are aware of. He believes in heredity as a cause, just as other vaso-motor

¹ Suppose this to be true, how does he account for its much greater prevalence in some districts than in others ?

pareses may be transmitted from parents to offspring; the *immediate* cause he thinks is *reflex* in nature, and points out evidences of correlation of vaso-motor tracts existing between those of the neck and genitals—*e.g.* the congestion of the larynx and 'voice-breaking' in boys and the functional aphonia of girls at puberty, and the fact that acute swelling of the thyroid may come on at the commencement of uterine trouble, instances of which I have seen. Nevertheless many such immediate causes are undetectable by the closest examination; besides, acute congestions of the thyroid arising in the way named often subside as suddenly almost as they arise, and are not examples of '*endemic*' goitre.

Potable waters are the vehicle of the cause.—The belief that certain *potable waters* contain the goitrogenous principle has descended to us from Hippocrates (B.C. 460), and has been held by Aristotle, Galen, Celsus, and Pliny, and is almost universally held in our own day, alike by physician and patient. That this view is correct is proved by the following facts:

(a) All the 'epidemics,' so-called, of goitre are explainable through the agency of drinking water. The 'epidemic' which occurred in mid-ocean amongst Captain Cook's crew only attacked those who drank a certain water; the others, who made use of the original supply, were not attacked.

(β) In Italy and in France, the drinking of certain waters has been resorted to with success for the purpose of producing goitre, and thereby gaining exemption from military conscription; 'telles sont, en Maurienne, les sources d'Argentine, de Pontamafrey, de Villard-Clément; dans le Briançonnais, la source de Saint-Chaffrey' (St. Lager, p. 191). St. Lager has investigated the truth of this statement, and found one individual who avowed that he himself had proved the efficacy of the goitrogenous water of Villard-Clément. Hacquet corroborated the above by experimenting upon himself with the waters of the Kropfbrunnen (goitre-springs). Jame ('Thèse de Montpellier, 1829') had a fellow-student who avoided military service by this device.

(γ) Change of water has often, in a goitrous district, been

followed by disappearance of the swellings of the neck. Numerous instances of this have been recorded by St. Lager and others. Dr. Johnson saw goitre disappear in Durham Gaol after change to a purer water ('Edin. Monthly Journal,' May, 1855).

(δ) On the other hand, a development of thyreoele in a previously non-goitrous district has been known to follow change of water. Billroth attributes the recent increase of goitre in Vienna to the introduction eight or nine years ago of the new water supply from Kaiserbrunn in Styria, where goitre is endemic.

(ε) Many cases have been recorded by St. Lager and McClelland, where, in the same village and under the same conditions of social life and of locality, those who drank a particular water suffered, while those who did not do so escaped—*e.g.*, in the village of Deota, in the province of Kemaon, south of the Himalayan mountains, as described by McClelland, and quoted by Sir Thomas Watson in his 'Principles and Practice of Physic,' vol. ii. pages 786-7.

Not due to want of iodine, nor presence of organic matter, &c.—Granted, then, that drinking water is the vehicle of the goitriferous principle, we have next to discover what that principle really is. It is certainly not owing to the absence of iodine, as stated by Chatin; neither is it caused by organic matter, fluorine, silica, lack of phosphates, carbonic acid, or oxygen, nor turbidity, as has been fully proved in each case by St. Lager.

Coldness of water and snow-water.—Hippocrates, Aristotle, Galen, and Celsus, blamed coldness of the water; many have attributed it to snow-water, but its occurrence in regions such as in the Sahara negatives this idea.

Magnesian and lime salts.—On the other hand, the coincidence of goitre with sedimentous water is very frequent. Since the elaborate geological inquiries of M. Grange ('Ann. de Chimie et de Physiologie,' vol. xxiv. p. 364) and the analyses of the waters of the Isère, magnesian salts have often been blamed; but this view, owing to geological reasons, has been given up even by M. Grange himself. ['M. Grange a renoncé à con-

sidérer la magnésie comme la cause essentielle du goître' (St. Lager, p. 237).] In the goitriferous waters of Helmsley in Yorkshire the amount of magnesia present varies from only '25 to '9 grains per gallon (Dr. Bruce Low). That magnesian salts cannot produce thyreocoele is also proved by therapeutics.

The favourite view, that the impregnation of water with lime and magnesian salts is the cause, has been supported by many learned, careful, and laborious observers. The evidence that the waters of goitrous districts is derived from limestone and dolomitic rocks, or from serpentine¹ in the granitic and metamorphic regions, is apparently very strong. The investigations include the Alps, Pyrenees, Dauphiné, some parts of Russia, and districts in Oude in North-West India, as well as England and many other parts. A table compiled from Dr. McClelland's work is very striking, and shows the marked preponderance of goitre in limestone districts:—

GOITRE AND CRETINISM IN KEMAON (OUDE).

Water derived from	Population	Goitres	Cretins	Percentage of population affected	
				Goitres	Cretins
1. Granite and gneiss .	—	—	—	'2	—
2. Mica-slate and hornblende . . .	50	—	—	—	—
3. Clay-slate . . .	3,957	29	—	'54	—
4. Green sandstone .	200	—	—	—	—
5. Limestone rocks .	1,160	390	34	33	3'1

On the other hand, in addition to the reasons already affirmed against magnesian salts being the productive agent, there are analyses of Continental goitriferous waters which show that magnesia may be absent—*e.g.* in Rheims, by Maumené; in Auvergne, according to Bertrand; in Lombardy, according to Demortain; while St. Lager mentions other cases. Again, proofs are now almost innumerable

¹ *Serpentine*, a rock (of granitic or metamorphic origin), generally unstratified, chiefly composed of hydrated silicate of magnesia, and common in many Alpine districts and in the United States.

showing that there need not be any excess of lime; St. Lager found no relation between hardness of water and lime-salts. Hacquet, however, had previously shown that in the Alps of the Tyrol and of Salzburg, of Styria, and of Carinthia, he found scarcely 2 per cent. of the population, living upon the mountains composed of limestone, affected with goitre, whilst on the older schists of these countries the subjects of goitre and cretinism form a considerable proportion of the population.

Iron pyrites.—St. Lager enumerates similar examples where goitre is absent from limestone districts, and prevails upon other geological formations (St. Lager, 231-8), and infers from the results of his numerous inquiries 'que l'endémie goîtreuse coïncide avec les terrains métallifères. Au premier rang se présente la pyrite de fer. C'est l'élément le plus abondant et le plus fréquent, le seul qui ne manque jamais : sa présence se manifeste par les cristaux de sulfate de chaux dans les roches calcaires ; par le sulfate de chaux et le sulfate de magnésie dans les terrains dolomitiques ; par les efflorescences de sulfate de fer et d'alumine dans les autres roches. On sait que le sulfure de fer se change en sulfate ferreux, celui-ci en sulfate ferrique : ce dernier se décompose au contact des calcaires et des dolomies, et produit des sulfates de chaux et de magnésie qui ne préexistaient pas dans les roches. L'abondance de sulfure de fer est aussi en relation avec celle des sources ferrugineuses et sulfureuses. Au second rang, dans l'ordre de fréquence, apparaît la pyrite de cuivre : sulfure double de cuivre et de fer.' (St. Lager, p. 444.)

He further thinks that where the sulphide of iron exists in a form (*e.g.* in the magnetic pyrites) readily convertible into sulphate of iron, there the endemicity is most marked. This supposition is absolutely necessary to support his theory, as sulphide of iron, being insoluble, cannot affect the water to any degree. To prove his view he attempted experiments upon animals, but these were unsatisfactory. He explains McClelland's results by the supposition, based on a statement of that writer, that in the limestone districts of Kemaon the

water had traversed the metalliferous strata of the rocks. The apparent weak point in his results is the want of chemical analyses to back up his geological data.

Occurrence—in Weardale.—So far I have limited myself to describing the views of authorities on the etiology of goitre, when my attention was directed to this subject ; I shall now discuss these supposed etiological factors in reference to my own district—that of Weardale, and especially as regards the village of Stanhope (situated ten miles from the source of the Wear) and its neighbouring villages. Along the first thirteen miles or so of the Wear Valley, goitre is endemic, coinciding with the occurrence of limestone ; farther east (at Wolsingham, which is situated on gravel), little or no goitre occurs ; still farther east, the millstone grit and true coal-measures appear, on which goitre is not endemic, just as in Northumberland it does not encroach on the Cheviot porphyries.

In Stanhope.—In the village of Stanhope itself, the endemic influence is not marked to a very great degree, yet I have observed at least twenty-two cases in three years in which it could be proved that the patients had almost never drunk any water other than that supplied to the village, the population of which is about 2,000 ; in addition, I have seen about forty other persons in Stanhope who had developed thyreoceles previous to the present water supply being laid on about eighteen years ago, or who had contracted the disease in another part of Weardale or some other goitrous district. This total of three per cent. of the population does not represent the whole of the cases in the village, but merely those which have come under my immediate notice.

Geology of Weardale.—The *geology* of Weardale¹ is contained within the limits of the Yoredale Rocks, or the higher carboniferous or mountain limestone—the ‘middle strata’ of the carboniferous system ; the great Whin sill is the base stratum, and the millstone grit the highest, as it tips the higher hills on each side of the valley. Stanhope stands on the north bank of the river Wear (at an elevation of 700 feet

¹ For this account the author is largely indebted to Mr. George Race, sen., of Westgate, in Weardale.

above the level of the sea), and consequently derives its water supply from the strata on the same side. The little Whin sill, or three-post limestone, forms the bed of the river at Stanhope, and the millstone grit is developed on Collier Law and Weather Hill (about two miles to the north and north-west), which rise to the height of nearly 1,000 feet above the village; in this series of rocks between these limits are found as we ascend :—

1. Limestones.

2. Hazles (sandstones and grits).

3. Numerous shale beds.

(1.) **Limestone.**—In this northern development are four limestones above the river-bed—viz. (a) *The four-fathom lime*, close at the back (north) of the village.

(b) *The great lime* (ten to eleven fathoms in thickness), about 100 feet or so higher up the hill towards the village of Crawleyside, which is situated above c.

(c) *The lesser lime*, a little above the great lime.

(d) *The fell-top lime* appears higher up the mountain, and is only a very thin post, but highly impregnated with iron.

The water used by the inhabitants previous to about seventeen or eighteen years ago, when the present supply was laid on, would percolate through the three first named strata, and was then very hard. The Weardale limestones are intersected by numerous lead veins (galena) and deposits of iron (chiefly as ironstone—i.e. brown hematite composed of the oxides and carbonate of iron with a small amount of iron pyrites).

(2) **The hazles** (or sandstone and grits) in this area are numerous. The firestone on Crawley Top (immediately to the north of Stanhope) contains iron pyrites, and is popularly famous for the superiority of its water, as are all the other strata still higher, but especially the millstone grit, which occurs *above* the fell-top lime (the firestone of Crawley being below the fell-top lime, but above the lesser limestone).

(3) **The shales** (a variety of schist or clay-slate) in this area are likewise numerous, and contain a large amount of iron in the form of thin beds of compact iron and thick beds

of the nodular form (composed chiefly of the carbonate of iron, with a small amount of pyrites); and that these shales impregnate the water is notorious from the numerous iron-springs in the locality, for wherever an iron-spring exists one can predict a shale-bed at or above the level of the spring, whether the bed shows itself at the surface or not; and this is the source of any iron found in the Stanhope water which is collected from the strata *overlying* the limestones and brought into the village by pipes.

Rookhope.—In Rookhope, a small village of about 500 inhabitants, situated on a small northern tributary of the Wear, goitre is more common, and the tumours are larger. Its geology is similar to the above, but there is much less limestone above the bed of the rivulet on which it stands, and the supply of water is got from wells or springs in the village. Rookhope is situated *upon* the great limestone, which is here *very thin*, as are all the limestones at this part; ironstone veins are numerous, but these affect the water extremely little (*vide infra*).

Neighbouring districts.—The geology of Alston Moor,¹ where goitre is very prevalent, is similar to that of Weardale, but there *deeper* limestones are developed. In Upper Derwent Valley (the Derwent is a southern tributary of the Tyne) and Edmondbyres, the only limestone above the bed of the river is the fell-top, the other strata being the same as in Weardale; and here Mr. Montgomery informs me goitre does not occur to the extent of 1 in 50 as compared with West Allendale, near Alston.

Diminution of goitre in Stanhope.—In Stanhope, previous to the present water supply, that used was very 'hard,' and goitre is said to have been more common than at present. That this diminution of endemicity is not solely due to change of water is exceedingly probable, as about the same time the railway was brought up to Stanhope, followed by an influx of men from various southern counties to work in the limestone quarries, which resulted from the facilitated means of export for the limestone. The railway opened up also

¹ Here, Dr. Savage says, goitre affected the lower animals—chiefly dogs.

opportunities for the inhabitants leaving home more frequently and intermingling with others from a distance. This occasional change of residence may possibly partially explain why goitre does not affect, except rarely, those in good circumstances, added to perhaps the absence of any hereditary tendency. This diminution of goitre has been observed in other districts as they have become opened up and more civilised. We can only rely, however, upon a *popular* belief for its diminution in our day ; and *popular* beliefs are often fallacious—*eg* some people think that goitre has almost disappeared from the village, probably owing to the women having become more particular in their dress. That it has not done so is proved by my figures, as well as by the fact of its occurrence within ten days, in one case, after the patient came to Stanhope, and in others who were already goitrous experiencing an augmentation of their thyreocoele after coming here ; whilst the tumours of others again do not improve by coming to Stanhope.

The drinking waters of Stanhope and Rookhope.—

I have tested the drinking water of Stanhope, and have found that there is *not the slightest* change in it on the addition of oxalate of ammonium, proving that there must be *less than four grains of lime salts in the gallon*, an exceedingly small amount. This disproves at once the theory of goitre being due to lime, as is shown also by its occurrence in other neighbouring districts situated above the limestone. In Rookhope, where goitre is more abundant, the water does not contain more than six grains of lime salts in the gallon. On the other hand, I have found water containing at least thirty grains in the gallon, without the endemicity being more marked than in Stanhope.

Stanhope water, when tested with the ferro-cyanide of potassium, gives a negative result, proving the absence of any but a very minute amount of ferric salts ; but when tested with the ferri-cyanide, the colour becomes a faint bluish green, sufficiently visible to be distinctive, showing the presence of iron in the ferrous condition, which Dr. Parkes, in his 'Practical Hygiene,' says is rare (*i.e.* the presence of ferrous salts).

As the iron is not in the least degree perceptible to the taste, it must be in less amount than '2 grains per gallon (Dr. de Chaumont, 'Army Medical Report' for 1862, vol. iv. p. 355).

Arguments against the theory of goitre being due to iron salts.—The occurrence of iron in Stanhope water tends to support St. Lager's view, but against this theory of causation I would mention:—

(1) Parkes states that a third of a gallon of water is used on an average as drink (water, tea, and coffee) by a healthy adult, so that by drinking Stanhope water such an individual consumes one-fifteenth of a grain of iron in the twenty-four hours; and who but the most ardent follower of Hahnemann can believe that such a dose of iron taken daily is capable of producing so great an effect as enlargement and degeneration of the thyroid. St. Lager thought he produced an hypertrophy of the thyroid in mice by adding sulphide of iron to their food for some months, but his experiments were not satisfactory so he discontinued them; but what reason had he for supposing that the iron existed as sulphide in the water—an insoluble salt; only an *extremely small* amount if any of the small percentage of iron can be sulphide, the most will be either oxide or carbonate, as these latter exist in *much* greater proportion, at any rate in this district, as is shown by an analysis of some Weardale 'brown hematite' by Mr. Spiller, of the Government School of Mines, which contained only '03 per cent. of sulphide, whilst the total quantity of iron (peroxide, protoxide, and carbonate) was more than 50 per cent.—that is, in proportion of 1 of sulphide to 1650 of the other salts of iron, and these latter are more soluble. This analysis also showed that protoxide of manganese existed to the extent of 3'06 per cent.

If, then, the iron in the water does not exist there as sulphide (except to an inappreciable extent perhaps), and if thyreocoele is produced by the iron, why should not its administration by the ordinary method of therapeutics not give rise to goitre? Again, a patient taking a dose of most of the iron preparations experiences a blackening of the tongue and teeth—*i.e.* part of the iron is thrown down there as sul-

phide. Such a patient taking iron regularly for a time will get into his system infinitely more sulphide than he could possibly obtain from the drinking water, yet he does not develop thyreoele.

(2) I have examined the drinking water from other localities (*e.g.* Rookhope) where the endemicity is *more* marked, and yet have failed to get any reaction, except in one sample where the change was *very* slight, and much less distinct than with Stanhope water, using the same reagents as before mentioned for the presence of iron. This does not prove that a trace of iron may not be present, but it does prove that there is much less iron in them than in Stanhope water, which gives a reaction. So that, if goitre is due to iron salts, it ought to have been present in larger quantity where the endemicity is greater; hence we see there exists no direct relationship between the quantity of iron salts in the potable water and the degree of endemicity of thyreoele. This further proves that iron may be present in a locality without influencing the water to any perceptible extent.

(3) We have seen that the amount of iron as sulphide in the water is inappreciable, and that the whole of it (almost) can be accounted for from other sources than the pyrites. We shall see later on that goitre may be present on almost any geological stratum, and from this fact it seems probable that iron was the only metal which could be seized upon by St. Lager as the cause of thyreoele, simply because its presence is almost universal. It is supposed that it forms about three per cent. of all known rocks; yet goitre does not possess such a universal distribution. For example, in the table already quoted from McClelland, iron (generally as oxide, but as sulphide in slate) occurs in granite, gneiss, mica-slate, hornblende (sometimes to the extent of twenty-five per cent. as oxide), clay-slate, and greensand, yet goitre does not occur on them according to his statement.

To my mind the occurrence of goitre on almost every stratum suggests the idea that it cannot be due to any metal-liferous impurity in the water, and possibly the 'goitrogenous principle' may elude the analysis of the chemist altogether.

The goitriferous waters of Helmsley.—Dr. R. Bruce Low in his paper publishes the minute analyses of six goitriferous waters from Helmsley, the chief points in which are that lime salts were present in all in varying amounts (3 up to 32 grains per gallon), though the endemicity did not vary; a much larger amount of oxide of iron and alumina (·16 to ·76 grains per gallon) was found than is usually the case, apparently supporting Dr. St. Lager's view; 'but,' he says, 'it is difficult to understand how iron can be the deleterious element, since we are accustomed to give it so largely and so constantly in daily practice, with the best results. I have often given it when treating goitre with perceptible benefit, especially those goitres associated with profound anæmia, as is often the case.' With regard to the geology of his district, Dr. Bruce Low states: 'The district may be said geologically to stand on the upper and middle oolitic formations. The plain consists of alluvium upon Kimmeridge clay, in which iron pyrites is found. The hills are mostly tabular, and consist of Kellaway's rock, Oxford clay, and Calc grit. In one valley alone, at the extreme western boundary of my district, is the lias formation met with.' Its presence on the oolites and lias is peculiar to his district; these oolites, although identical geologically with those of the south of England, differ from them, it is said, in composition. Iron is found in many parts of the district. [See Dr. Low's paper.]

Professor Lebour's researches.—Mr. Lebour ('On the Geological Distribution of Endemic Goitre in England,' by G. A. Lebour, M.A., F.G.S., Professor of Geology of the University of Durham College of Physical Science, Newcastle-upon-Tyne) says: 'In England, as in France, one point—and one alone of any importance—seems to be established as being common to those rocks on which goitre is found not to occur: the absence of limestone together with that of metallic impurities, and especially sulphide of iron. In both countries the rocks which support most goitre are such as are both calcareous and metalliferous. But there are plenty of facts to show that metalliferous impurities alone cannot be credited with the origin of the disease, else the

Devonian and the granite would not be free from it. Neither will the absence of limestone alone be sufficient to check the growth of bronchocele, else the lignitiferous beds of France and the ferruginous sands of the Weald would not support it.'

Idiosyncrasy.—Apart from the influence of water, I am convinced that individual susceptibility or idiosyncrasy plays a most important part in the development of the affection, for it is a matter of daily experience to find several persons, even of the same family sometimes, exposed to exactly the same conditions of life, whilst only a proportion of them become goitrous. Possibly heredity may enhance this susceptibility, but the dominating cause is the *endemic* influence.

No new theory offered.—In conclusion, I have no new theory to offer, as our knowledge of the disease is as yet too imperfect.

DISTRIBUTION OF GOITRE (GEOLOGICAL AND GEOGRAPHICAL).

Geological distribution in France.—The geological distribution of goitre has been most completely ascertained in France by Dr. St. Lager, a summary of whose results Professor Lebour has translated and tabulated (in his paper already referred to) thus:—

THE GOITRIFEROUS AND NON-GOITRIFEROUS ROCKS OF FRANCE.

	<i>Goitre is Endemic on :</i>	<i>Goitre is Not Endemic on :</i>
RECENT		Alluvial deposits.
GLACIAL		Drift deposits
PLIOCENE		Pliocene deposits generally.
		The fahluns of Touraine, Gironde. &c.
		The Beauce limestone.
	The lacustrine limestone.	—
	The pyritous and gypseous mottled clays	—
MIocene	The metalliferous arkose of Auvergne.	—
	Molasse with pyritous lignites of Savoy and Dauphiné.	—
	. . . . .	The Fontainebleau sandstone.
	. . . . .	The upper Nagelfluh.

<i>Goitre is Endemic on :</i>		<i>Goitre is Not Endemic on</i>	
EOCENE	{	The gypseous marls of Paris.	
	{	The 'calcaire grossier' of the Paris basin.	
	{	The Brie limestone.	
	{ Sands and clays with pyritous lignites of the Paris basin. The Nummulitic pyritous limestones and black shales of the South of France. Clays with pyritous lignites of Provence and Languedoc.	— —	— —
CRETACEOUS	{ The chalk, with flints and iron pyrites of Northern France. The chalk marl. The upper greensand, with iron pyrites. The gault, with pyritous clays. The pyritous marls of the lower greensand.	The white hippurite limestones of the South. The 'Urgonian.'	
		— —	— —
		— —	— —
		— —	— —
JURASSIC	{ The Kimmeridgian (rarely) with pyrites.	The Portlandian.	
	{ The lower Oxfordian, with pyrites (= Kellovian). The inferior oolite (only at the outcrop of the well-known bed of pyritous ironstone). Liassic, bituminous, and pyritous marls, lignites, arkoses, and shales.	The Corallian. The upper Oxfordian.	
		— —	— —
		— —	— —
TRIASSIC	{ The mottled pyritous marls of the Keuper. The Muschelkalk (very variable in distribution). The variegated grit (grés bigarré).	— —	— —
		— —	— —
PERMIAN	{ The Autun shales (pyritous and bituminous).	— —	— —
CARBONIFEROUS	{ Coal measures (only at outcrop of pyritous coals). Anthracitic pyritous shales. Metamorphic coal measures, with veins, &c. Carboniferous limestone.	Coal measures.	
		— —	— —
		— —	— —
DEVONIAN	{		
SILURIAN & CAMBRIAN	{ Schists and other highly-altered deposits, where they contain metalliferous veins.	— —	— —
ERUPTIVE	{	Granite and gneiss. Porphyrites and other igneous rocks.	

Geological and geographical distribution in England.—I have compiled the following table by the aid of Professor Lebour's paper (pages 4 to 7):—

Geological Formation.		Geographical Distribution, &c.	Goitre.
POST-TERTIARY	{ Deposits of sand, gravel, and clay Drift deposits . . . }	. . . . .	Absent.
TERTIARY	{ Pliocene . . . Miocene . . . Eocene . . . }	{ Including the London basin and that of Hampshire and the Isle of Wight . }	Absent.
CRETACEOUS	Chalk with flints . . .	{ In Surrey, Sussex (as at Newhaven), Hampshire, Dorsetshire (doubtful), Buckingham (as about but not in Beaconsfield), and Kent (rare) . . . }	Present in scattered cases.
	Drift chalk . . .	In Norfolk	Endemic.
	Upper greensand . . .	In Sussex and Kent . . .	
	Gault (Folkestone marl; contains iron pyrites)	
	Lower greensand . . .	{ Especially at Ampthill in Bedford; sparingly in Surrey . . . }	
	Wealden { Weald clay and Hastings sand (ferruginous) . . . }	About Tunbridge Wells, at Speldhurst, Haselmere, and Horsham . . .	
JURASSIC	Oolites	Except near Helmsley in Yorkshire	Absent.
	Lias	{ Which extends from Teesmouth to Lyme Regis in Dorset, and contains much iron pyrites. Except at South Petherton, and near Helmsley . . . }	Very rare.
TRIASSIC	Rhatic beds . . . . .	. . . . .	Absent.
	New red sandstone . . .	{ In Cheshire and west side of river Eden in Westmoreland, &c. . . In Devon and at Wombourne, near Wolverhampton. . . }	{ Absent. Endemic.
PERMIAN	{ Dolomitic or magnesian limestone. Red sandstone . . . }	. . . . .	{ Absent (practically).

Geological Formation.		Geographical Distribution, &c.	Goitre.
CARBONIFEROUS SYSTEM	True coal measures Millstone grit	. . . . .	Absent.
	1. Grits, shales, & hazles (often ferruginous)	As in certain localities in Weardale, &c. . . .	Present.
	Carboniferous limestone	Along each side of Pennine Range—i.e. in west of Northumberland (South Tynedale, Allendale, Redesdale, and Upper Coquetdale); in west of Durham (Upper Weardale and Teesdale); in west of Yorkshire (especially at Hawes); in Nottinghamshire; in Derbyshire (worst at Stoney Middleton); in Cheshire; in Lancashire; in Westmoreland (on east side of Eden Valley; on west side is the new red sandstone, from which it is absent); and in Cumberland (especially in the Alston mining district); in the Malvern district, the Forest of Dean, in Flintshire, and at Bristol	Endemic in the highest degree.
DEVONIAN	or old red sandstone . . . . .	. . . . .	Absent (or nearly so).
SILURIAN	. . . . .	. . . . .
CAMBRIAN	. . . . .	. . . . .
AND PRECAMBRIAN	(Iron pyrites occurs in slate)	
ERUPTIVE	Granites, porphyries, and eruptive rocks generally . . . . .	. . . . .

Many more details are required before such a table can be complete. Professor Lebour remarks: 'On the whole there is a striking sameness in the geological distribution of the disease in the two countries.' From the above tables it will be seen that goitre is not necessarily restricted to limestone districts, and that it is occasionally absent on strata containing iron pyrites. For further remarks see 'Etiology.'

Geographical distribution.—The goitrous districts of *England* have been pointed out in the preceding table. In *Scotland*, according to St. Lager, goitre is found in Perthshire and the east part of Fife, in Roxburgh, the

upper part of Selkirk and Peebles, the east part of Ayr, near Lanark and Dumfries (along the Nith Valley, hence the name 'Nithsdale Neck'), Kirkcudbright, the east part of Wigton, and in the west of Berwickshire; also on the coast of the Isle of Arran, especially towards Shiskin.

On the Continent, the valleys of the Alps and Pyrenees engender it most; it is found in France, mostly in Savoy; in Spain; in Germany, mostly in the Black Forest; in Switzerland, where it is worst in the Valais; in Austria, especially in Styria; in North Italy (about the Alps); in some parts of Russia, chiefly about the Altai Mountains; and in Norway.

In Asia it occurs in some Western parts of Siberia; in Western China and Tartary; in Bengal, especially along the line of the Himalaya Mountains (in Calcutta and in some villages of Lower Bengal, where thyreocele is extremely endemic, the *alluvial* deposit is so thick that practically it is impossible to find rock, according to Dr. H. T. Bowman), and in Oude (for particulars see Aitken's 'Science and Practice of Medicine,' vol. ii. pp. 659-662); and in the island of Sumatra.

In Africa, the negroes of Barbary were seen to be goitrous by Mungo Park, and they even blamed water from certain wells; thyreocele has been observed among the Marungus, a warlike tribe on the lofty peaks (7,000 feet in height) on the mountains of the western bank of Lake Tanganyika (Thompson's 'Central African Lakes'). Livingstone in his 'Last Journal' says goitre and hydrocele are frequent in the Lopere and Kebuiré districts in Central Africa (Dr. Bruce Low).

In North America many cases occur in the vicinity of the Blue Ridge in Virginia, in Pennsylvania, New York, New Hampshire, Vermont, and at Edmonton and along the course of the Saskatchewan River (Richardson).

In South America the disease prevails in the upper and the lower course of the Magdalena River, and in the high flat country of Bogotá, 6,000 feet above the bed of the stream. The first of these regions is a thick forest, while the second and

third present a soil destitute of vegetation; the first and third are exceedingly damp, whilst the second is peculiarly dry. In the first the air is stagnant, in the second and third the winds are impetuous. In the first two the thermometer keeps up all the year at 22° or 23° C.; in the third it ranges between 4° and 17° C. (Humboldt). Goitre is also common at the base of the South American Andes and in most of the countries of South America, extending as far south as the north of Patagonia.

'Endemic' nature of goitre.—From the above wide distribution of goitre we see that no country and no race is free from it; it does not, however, occur widespread in any country, but is confined to certain districts therein, where it is '*endemic*.'

Not restricted to man.—In affected localities goitre is not always limited to the human species, for horses, dogs, pigs, sheep, goats, mules, antelopes, and other animals may be goitrous.

DIAGNOSIS.

As a rule the tumour of goitre is sufficiently characteristic to prevent error in diagnosis. The site of the swelling and its following the up-and-down movements of the trachea in swallowing point at once to thyreoceles.

Cystic or fibrous?—Cysts may be known from fibrous growths either by more or less fluctuation, or more certainly by the hypodermic needle; when a cyst contains much soft trabecular structure the fluid drawn out is mixed with blood, and pure cysts often bleed readily if much fluid is withdrawn. These points must be borne in mind.

Inflammation of the thyroid is rare, occurs only in the scrofulous, and is readily known by its signs.

Scirrhus is also rare, and is recognised by its extreme hardness and its lancinating pain; usually only a small part of the gland is affected, and it rarely attains much size. The age, general condition of the patient, and the involvement of glands are also aids in diagnosis.

Carotid aneurism may be simulated by a *pulsating thyreocele* when the enlargement (of one or both lobes) is circumscribed and seated immediately over the carotid, from which it receives pulsation ; the latter is differentiated by its following the movements of the windpipe in deglutition, by its being more or less separable from the artery when the pulsation ceases ; and although the thyreocele may be confined chiefly to one lobe, it always affects the isthmus more or less, and the most firmly fixed portion stretches towards the *middle* line, whereas in carotid aneurism the firmest attachment is under the sterno-mastoid.

Aneurisms of the thyroid arteries are known by their site and pulsation, and by their diminution or disappearance under firm pressure.

Tracheocele, one of the greatest of rarities, is easily recognised by its varying size, its increase in forced expiration with the mouth and nose closed, and by the impulse conveyed to the hand placed over the sac when the patient coughs.

TREATMENT.

General indications.—The indications are—to remove from the district where the disease is endemic or to refrain from drinking the water known to be the cause. To fulfil these indications I recommend an occasional change of residence to the seaside, which usually proves very beneficial, improvement taking place almost immediately ; here, medicinal treatment may also be employed, or the patient may resort to sea-water or sea-weed baths, which also tend to the dispersion of the growth.

Iodine.—As with the poison of mercury and lead, so with thyreocele, *iodine* is the remedy *par excellence* for dispersing the tumour, and probably also for eliminating the goitri-ferous poison, whatever that may be. Iodine has thus acquired the reputation of being almost a specific against the disease, though not in the same absolute sense as that in which we look upon quinine as a specific for ague. Dr.

Coindet, of Geneva (in 1821), was the first to make this remedy extensively known, though Dr. Straub, of Hofwyl, laid claim to priority in its use; before their time *burnt sponge* was chiefly employed and found efficacious (probably owing to the iodine it contains), and the bladder-wrack, the *fucus vesiculosus*, which, with other plants of the same family, yield the sodic compound of iodine, had also been used successfully.

Iodine should be employed externally at first, and if this does not succeed, it should be given internally as well. *Externally*, it may be used as the tincture or the ointment; or compresses wrung out of a saturated solution of the iodide of potassium, wrapped around the neck at bedtime and left on till morning, I have found a cleanly method of application; or the *unguentum potassii iodidi* may be used. *Internally*, the iodide of potassium (gr. ij.—xx., t.d.s.) is the best form for administration. *Bryant*, I understand, recommends the suspension of pure iodine above the patient's head in bed, so that during the night he may inhale the vapours of the drug. Should the patient require any constitutional treatment, for anæmia, menstrual disorder, &c., this must also be attended to. The length of time required by the iodine treatment is generally in proportion to the duration of the growth; in recent cases two or three weeks suffice, but more often months, or even a year or more, are required. This treatment is not very successful with cystic thyreoceles.

Iodide of mercury.—In India, the application of an ointment of the *biniodide of mercury* has been found very efficacious when applied and rubbed in for ten minutes by means of an ivory spatula about one hour after sunrise, 'the patient sitting with his goitre held well up to the rays of the sun, as long as he can bear the exposure. In the course of the day the ointment should again be rubbed in gently, and the patient then sent home, with orders not to touch it with his hands, but to allow the ointment to be gradually absorbed. A second application is sometimes necessary in very bad cases' (Aitken). In 1855 no less than 500 or 600 persons were sometimes treated in a single day, and it is estimated

that altogether about 60,000 patients have been so treated, 'so that gradually the disorder is thus being extinguished' (Mouat, 'Indian Annals' for April, 1857). I have a patient on whom this method was tried with little or no benefit. At a meeting of the London Medical Society (March 17, 1884), Sir Joseph Fayrer spoke of the efficaciousness of this treatment; but Dr. R. Crocker, who has used this ointment and a strong fire instead of the sun, related that his success was 'not marked.'

Dilute fluoric acid.—Dr. Woakes, reasoning from the 'physiological relationships between drugs belonging to the same physiological groups' and from the successful use of iodine in thyreocoele, was led to employ the untried *fluoric compounds*. He uses a half per cent. solution of the redistilled commercial fluoric acid, and gives thirty drops of this to begin with, increasing the dose up to two drachms three times a day if well borne. Occasionally it produces nausea and slight headache, and if so it should be temporarily left off. Of twenty unselected cases thus treated *to the end*, seventeen recovered, and three were not benefited (85 per cent. of cures). The period of cure required by this drug varied from one month to two years; the majority required from three to nine months' treatment. In some cases where iodine, even when injected subcutaneously, had failed, fluorine was successful. Dr. Woakes states that when fluoric acid is adapted to any given case, its effect is often immediate and rapid; 'in other cases, improvement goes on to a certain point only; the peripheral portions disappear, but its centre remains firm and hard as ever.' In such cases he uses iodine subcutaneously (*vide infra*), after which absorption begins again, and the acid only need be continued; occasionally a second injection is necessary—the fluoric acid treatment, he thinks, diminishes the number of injections required. ('Lancet,' March, 1881.)

Blisters, simple frictions, and the application of pressure by means of strapping have each been advocated as of service. The latter, however, is not easy to apply.

Quinine in certain cases.—Dr. Corley, of Dublin, had a

patient with a goitre of four months' growth, causing dyspnœa and dysphagia, and accompanied with violent headaches, recurring daily at the same hour, and associated with flushings of the face and throbbing sensations in the growth, with increase in its size, and the patient felt as if choking. Ten grains of quinine were given daily; in less than a week all the unpleasant symptoms were gone, and in six weeks the thyreocèle had completely disappeared. Sir William Mac-Cormac, who related the details of the case at the British Medical Association meeting at Belfast, thought it suggested a possible malarial origin of some forms of acute goitre, and that quinine should be tried when the exacerbations were periodic.

Surgical treatment.—The treatment above recorded suffices for the majority of cases, but should the growth not be dispersed by the exhibition of drugs, and should dyspnœa or other urgent symptoms persist, or should the dyspnœa be so severe as to render immediate steps necessary to save the patient from impending asphyxia, operative interference must be had recourse to. So long, however, as the growth is merely a deformity and does not give rise to any serious symptom, nor grievously encumber the patient by its weight, surgical treatment should not be employed, either for diminution or removal of the gland.

Parenchymatous injections of tincture of iodine.—This treatment may be adopted in parenchymatous thyreocèles when the previous methods have failed, or as an adjunct to them. It has been successful also when urgent dyspnœa was present, but when used in such cases the surgeon should be prepared to perform tracheotomy or some other operation to prevent asphyxia should it become necessary. It is an operation of comparatively little danger¹ if the following points are attended to—(1) the hypodermic needle should enter the *substance* of the thyreocèle to avoid throwing the fluid into the cellular tissue, which would probably result in

¹ One case of sudden death is recorded from simple injection, probably from thrombosis, the result of iodine and not air entering the circulation (*Victor Horsley*). To avoid this occurrence it is best to wait to see if a vein has been opened before the injection is made.

suppuration ; (2) *no air* should be injected (the precaution of tying a piece of tape round the neck below the tumour so as to compress the superficial veins should not be forgotten) ; and (3) avoid treating in this way old, partially calcified, and purely cystic thyreoceles. The tumour should be steadied with the left hand whilst puncturing, and 5 to 30 drops (beginning with 5) should be injected at a time, the pure alcoholic tincture being used. Slight tenderness and swelling usually result, but within seven days distinct, though perhaps slight, diminution of the goitre is observable ; should this be so, the injection should be repeated in varying parts once, or at most twice a week, until the tumour has disappeared. The injections should not be repeated too quickly, however, as rapid emaciation may set in, even in the most robust, as the result of subacute or chronic iodism, the other symptoms of which are languor, exhaustion, and nocturnal feverishness ; the eyes are sunken and bright ; urine albuminous, and sometimes the sputa are tinged with blood, the result of catarrhal inflammation (Billroth). Hence this method is contra-indicated in the very young and in weak individuals, especially if with a family history of tubercle. Iodine can be found in the urine and saliva a very short time after the operation. The effect of the injection is to cause coagulation and contraction of the structure of the thyreocèle and its colloid substance and to render them absorbable ; the rapidity of the absorption depending upon the character of the growth, recent and quickly-growing goitres being most easily dispersed (as they are also by the ordinary method). Others which are composed mostly of cicatricial tissue and with little blood-supply, or 'with non-vascular infarcts and pulpy substance,' are much less readily acted upon. When the colloid substance has been absorbed, the remaining structure shrinks into a cicatricial-like mass (Billroth).

The introduction of setons.—This procedure was employed as far back as the middle of the last century. In 1817, Dr. Quadri, of Naples, revived the practice of it. Most writers speak of its use, and many formidable thyreoceles and their urgent symptoms have been dispersed by this method

(see an account of two successful cases in the 'Lancet' of Jan. 4, 1884, by Mr. Henry Smith, King's); on the other hand, the operation is not without risk of producing blood-poisoning. The seton should pass well through the enlargement and should not be kept in longer than the establishment of suppuration, and care must be taken to prevent the exit of discharge and pus from being stopped.

Subcutaneous laceration was tried by Billroth, but the likelihood of septic infection occurring renders this operation undeniably most dangerous. Billroth cured one case; the second operated upon died.

Tenotomy of the sterno-mastoid and of the cervical fascia has occasionally relieved urgent dyspnoea, but the uncertainty of this result detracts from the advisability of the operation.

Ligature of one or more (superior or inferior) thyroid arteries has resulted in atrophy of the tumour on the side operated upon, but owing to the free anastomoses existing between the various arteries of the gland, collateral circulation may soon be established; for this reason, and because of the difficulties and dangers of the operation, and the uncertainty of its results, surgeons rarely resort to this treatment. In one recorded case the superior thyroid of one side pulsated so forcibly that the vessel was thought to be quite superficial, but on operating, it was reached with great difficulty owing to its deep seat.

Treatment of cysts.—*Cysts* may be treated by simple aspiration, injection, or incision.

Aspiration of a cyst can be only a very temporary resort, as the cavity in one or more days soon fills again, or blood or a sanguineous fluid may be rapidly effused into the sac after the operation; should the cyst walls be either very fibrous, cartilaginous, or partly calcified, they will not collapse. Occasionally it may ward off threatening asphyxia till more radical measures can be employed.

Incision of a cyst may be resorted to after failure of aspiration or independently; the free edges of the lining membrane may be attached to the skin so that the cavity may fill up

with granulations. The incision relieves the tension of the sac, and so may free the trachea (or nerves, &c.) from pressure.

Puncture and injection of cysts.—Dr. Morell McKenzie ('Clinical Society's Transactions,' vol. vii. p. 14) recommends the practice of injecting a solution of the perchloride of iron (neutral salt) in water (ʒij. ad ʒj.), after tapping a cyst with a trocar and canula. This destroys the secreting power of the lining membrane of the cyst and promotes suppuration, for which free drainage must be provided (as the iron is very apt to cause the formation of a plug), in order to ward off pyæmia. In operating the following recommendations should be observed:—Freeze the skin over the site of puncture; avoid transfixing any visible vein if possible and the trachea, inject enough of the iron solution to re-expand the cyst, keep the patient in bed (as the temperature rises after a successful injection), with the canula plugged, until the third or fourth day, when suppuration should have occurred, after which replace the metal canula by a large drainage tube (india-rubber with a middle layer of webbing) and apply poultices. In from one to five months the cystic growth usually disappears. To prevent air entering any accidentally injured vein during the tapping and injection, a tape should be tied pretty tightly round the neck below the tumour to compress the superficial veins; as a further preventive the nozzle of the syringe should be fixed at right angles to its body, so that the injection may be made without lowering the body of the syringe below the opening in the cyst. Billroth at Zurich treated twenty cases of cystic thyreocele by injecting after puncture one drachm of iodine (dissolved in ether) to one ounce of absolute alcohol. The injection was left in, and strips of gauze soaked in collodion were applied to the anterior half of the neck to cope against subsequent swelling. Cure resulted in every case so far as the cysts were concerned, but no effect was observable on any fibrous part of the tumour. Occasionally bleeding into a cyst, evidenced by rapid swelling, followed; and owing to this in one case the cyst was larger after than before puncture, when a thicker collodion bandage

and ice were applied, and no untoward occurrence took place. Sharp fever often follows the injection, and iodism, necessitating a few days' rest in bed, may occur. Gas often develops in these cysts, but should not be let out, as no harm comes of it, though some months may elapse before this and any effusion may be absorbed (Billroth).

Division or removal (partial or complete) of the isthmus of the gland.—In the 'Lancet' for 1875, page 120, Sir Duncan Gibb proposed division of the enlarged isthmus, or, better still, excision of a part or the whole of it. When this is done the lateral lobes recede from the trachea and become less prominent, and so relief from dyspnoea is obtained; moreover, shrinking of the hypertrophied lateral lobes sometimes follows, as in one of Mr. Holthouse's two cases, both of which were successful, at the Westminster Hospital, in which the thyreocèle with its visibly enlarged and tortuous veins underwent considerable diminution, and dyspnoea, dysphagia, and laryngeal cough also disappeared. Mr. Sydney Jones (for details of the last two operations by this surgeon, see 'Lancet' of August 30, 1884) has removed the isthmus six times and invariably with success, both as regards recovery from the operation and relief from urgent symptoms. These eight cases will doubtless encourage surgeons to choose this operation in preference to others when urgent symptoms render radical methods necessary, since, as compared with extirpation, it is comparatively easy and a much less dangerous procedure, and cannot be followed by the cachexia strumipriva. In some cases when the tumour is chiefly in the middle line and affecting the isthmus, a partial ablation, including the isthmus and part of the lateral lobes, should be performed, after transfixion by a double ligature. In these operations the lateral lobes are left, and these act as side-splints to the trachea and thus aid in preventing the fatal collapse or twist of the windpipe on itself, which occasionally happens if softening of any of the tracheal cartilages have taken place, as already referred to; as a further preventive the head should be kept perfectly steady after the operation by means of sandbags. Free drainage from the 'deep

gutter' thus made in front of the trachea must be secured whilst the healing process is going on.

Thyroidectomy.—The removal of a thyrocele or of the whole thyroid gland by excision in rare cases may be rendered necessary, where either from failure to obtain relief by other operations or where the tumour has burst and the suppuration is exhausting the patient. Kocher's results have surrounded the question of *total* removal of the thyroid with extreme interest (more particularly if the patient be young and still growing), as the cachexia strumipriva is an unwelcome *sequela*. To avoid such a result *partial* is preferable to *total* excision.

As to the mortality from this operation, previous to 1850, it was about 40 per cent. Kocher in 1883 had performed partial or total extirpation 101 times with 12·8 per cent. of deaths. Previous to 1876, Billroth had excised 36 thyroceles with 13 deaths (Billroth's 'Clinical Surgery,' translated by New Sydenham Society, p. 175)—a mortality of 36·1 per cent. ; at the Surgical Congress in Berlin, in 1883, Dr. Wolfler, however, stated that this surgeon had altogether operated 68 times with a death-rate of 7·3 per cent. ('British Medical Journal,' August 2, 1884, p. 231). [There must be some discrepancy in one or other of these accounts of Billroth's cases, for had the 32 cases operated upon since 1876 all been successful, in the total of 68 cases there must still have been 13 deaths—*i.e.* 19·4 per cent of fatal cases.] Sir William MacCormac stated at the last annual meeting of the British Medical Association at Belfast that the total number of non-malignant goitres operated upon since 1877 appears to be 240, with a mortality of 11·6 per cent. ; counting cases of *total* excision only, the death-rate differs very little, being only 12·1. From this it will be seen that complete is not more dangerous than partial removal of the gland. The present rate of mortality from this major operation justifies its performance, especially when done antiseptically, in those very rare cases which require it.

In all operations upon the thyroid it is of paramount importance to guard against a septic condition of the wound ;

should this not be accomplished, septic infiltration of the cellular tissue of the neck very readily and sometimes very suddenly appears, often without any very obvious outward signs, whilst the result is almost invariably fatal. In thyroidectomy, it is essential—(1) to control the hæmorrhage as far as possible by tying all bleeding points as soon as they arise, and to cut the enlarged veins (which are not only very huge in size, but whose walls are extremely thin and delicate, being easily torn) between double ligatures after being freely exposed, and to secure as soon as possible by ligature the four principal arteries, and when present the enlarged thyroidea ima, and (2) to avoid injury to the recurrent nerve. Neither of these points was attended to in the old method of operation, hence the former dire results: by this method the capsule was slit up, the mass enucleated as quickly as possible without paying heed to bleeding, and the pedicle tied *en masse* with double or quadruple ligatures. Should only excision of a thyreocèle be attempted, the surgeon must avoid detaching the whole mass of the gland, which may easily be done if care be not taken, and thus the operation will be rendered more complicated and dangerous. It should be noted that if more than ligature be required to staunch the bleeding, liquor ferri perchloridi must *not* be used, as it attacks the tracheal cartilages; ice, pressure, or acu-pressure must be employed instead. Further, it is very desirable if possible during the operation to avoid tracheotomy, as this increases the danger immensely, as the wound then becomes speedily septic; under such circumstances, in the hope of avoiding the fatal mediastinal infiltration, it is the best plan to treat it as an open wound with frequent irrigation. Should, however, extreme necessity compel the surgeon to tracheotomise, in order to save the patient from suffocation, the operation will be found one of great difficulty. Both Billroth and Kocher have found this. In forty-three of Billroth's cases in which the windpipe was not opened, all recovered; in three out of five in which it was opened, death followed. As a rule, however, during the operation, when the deep cervical fascia and the stretched muscles are divided, the breathing

becomes free, as the pressure is removed from the trachea, so that there is no necessity for tracheotomy. As a last general recommendation, it is necessary to add that the head must be kept quite steady during the whole of the operation, and *afterwards* to prevent collapse of the trachea, which is likely to occur should softening of any of the tracheal cartilages have been produced (Rose).

As the *steps of the operation* are not usually described in the ordinary text-books, I transcribe them, following the lines laid down by Kocher:—The skin-incision may be either angular or Y-shaped. When the growth is chiefly on one side, a median incision should be made first, from the upper margin of the tumour to the episternal notch. This will cut through the transverse communicating branch or branches of the anterior jugular veins, when both are present. From the upper end of this incision to obtain room an oblique cut may be made upwards and backwards in the direction of the mastoid process, reaching as far or farther than the anterior border of the sterno-mastoid. When the thyreocoele is bilateral, a similar oblique incision may be made on the opposite side of the neck. After division of the superficial fascia and platysma and deep fascia, the sterno-thyroid, sterno-hyoid, and omo-hyoid come into view, spread over the tumour. As a rule, especially if the tumour be large, these must be divided, and occasionally part of the sterno-mastoid as well. The growth, with its greatly dilated and friable veins covering it, will now be visible; the latter must be carefully tied one by one with a double ligature previous to division. (Over one hundred ligatures may be in this way required.)

The knife should now be laid aside and the tumour carefully separated with the fingers or handle of the scalpel, till the superior thyroid artery with its vein is reached at the superior lateral extremity of the thyroid body. These may be together or separately doubly ligatured and divided. The arterial walls of this and other vessels are generally very much dilated and thin. Now search for and with care isolate (previous to tying) the inferior thyroid artery, whose ligature should be applied *as far as possible from* the entrance

of the vessel into the tumour, in order to save the recurrent nerve from injury. The artery passes behind, partially encircling the nerve. The branches of the vessel after ligature may now be divided close to the tumour; bleeding will not recur owing to the previous tying of the trunk. According to Baumgärtner, of Baden-Baden, this method preserves the small vessels supplying the œsophagus, the trachea, and larynx from injury, as well as the recurrent nerve, and the cachexia of Kocher is less liable to follow. Credé, of Dresden, also supports this method, and he has never seen a case of cachexia strumipriva, though he has completely removed fourteen thyroids, one of which was from a boy aged sixteen years. The tumour should now be turned towards the middle line and lifted from the trachea, the isolation being conducted as gently as possible until the isthmus is reached, which must be divided with care. The same procedure may be conducted on the other side should the affection be bilateral. In sewing up the wound, free drainage must be provided for (Sir Wm. MacCormac).

APPENDIX.

NOTES ON THREE CASES OF CRETINISM (SPORADIC).

CASE I.

(*First seen in December, 1883.*)

J—E—, male, aged nine years, born near Stanhope, in a lime-stone district. Lies or sits about, but cannot walk. Mother states that he has never been able to raise or support his head from birth ; but signs of present state were first noticed at the age of nineteen weeks, when he suffered severely from bronchitis.

Family history.—Good. Father, non-goitrous ; mother has slight fulness of thyroid. Patient is the third born ; there are three younger children, all of whom are non-goitrous and healthy. Parents are not blood relations, are both temperate, and there is no disparity of age between them.

Present condition.—The child is thick-set, bony, and deformed, with puffy and putty-like complexion, and when seen was lying helplessly in his mother's lap. Length, 2 feet 10 inches. *Head*, much too large for body and face, being 22 inches in circumference, and he cannot support it. Forehead, depressed ; occiput, unlike most cretins, stands out almost at right angles from neck, and is very prominent. The two halves are not quite symmetrical. *Hair*, short, thick, and matted ; eyebrows and eyelashes, scanty. *Face*, large, puffy, and expressionless ; nose, flat and broad ; nostrils, wide ; lips, thick, with widely-open mouth, out of which hangs the *large, slobbering tongue* (not fissured), which almost fills it up. Lower jaw is pendulous and heavy. *Ears*, big, but not projecting. *Teeth*, wide apart, irregular and carious ; first milk tooth did not appear till the twenty-sixth month ; no signs of any permanent teeth. *Eyes*, widely separated and expressionless ; eyelids are puffy and swollen. *Neck*, short and thick ; the thyroid cannot be made out by hand ; an oval elastic tumour (measuring $2\frac{1}{2}$ inches by 1 inch) is seen prominent above

scapular end of each clavicle, and parallel with it. The superficial veins of neck and thorax are distinctly visible. *Thorax*, well-formed and large. *Abdomen*, large, broad, swollen, and pendulous. *Pelvis*, narrow and small. *Genitals*, undeveloped. He suffers from prolapsus ani. *Limbs*, very short, fat, flabby, and large-jointed, *occasionally* much swollen, but not pitting on pressure. No deformity of hands and feet, which are big. Legs are kept bent at knees. *Brain functions*.—He is completely idiotic, dumb, and only utters occasional groans. He can signify he wants milk by looking towards the pantry, and bread by looking at the cupboard. Until two years ago he was cleanly in his habits. All the *special senses* are *blunted*. The muscles are weak and flabby. He often sleeps for sixteen to twenty hours at a stretch; his calmness and placidity of temper are most remarkable. *Pulse* and *respiration*, slightly slower than normal. *Saliva* is copious, but tears are happily scarce. *Diet*, bread and milk.

[Mother attributes the cause to fright given her by seeing a drunken man whose tongue kept protruding out of his mouth, when she was three months pregnant.]

Diagnosis.—Based on: broad, placid, dull face; puffy and swollen features; thick lips and protruding tongue; the supraclavicular tumours, and idiotic condition. He lacks the squinting eyes, rugose and fissured tongue, and scurfy skin of the Mongol idiot.

Death.—He died on November 22, 1884.

Post-mortem examination.—Neck only allowed for examination. The swollen, myxœdematous condition of body had disappeared; the tongue had receded into mouth. No trace of thyroid could be found, and the supraclavicular tumours were composed of lobules of fat, the connective tissue of which was increased, and was white and glistening.

CASE II.

(First examined on December 6, 1884.)

History.—G—A— was born and has always lived in Stanhope; age, twenty years; male. Was apparently all right till five years of age, when it was noticed by his parents that he became 'slower' both in mental and bodily activity, and that he became swollen in the face, especially in the eyelids, &c. From this age he has grown in his body but very slowly, although head continued to grow, and now appears too large for body. He was a *very* slow learner at school, and can now only read short words, and knows little or nothing of arithmetic, yet takes an interest in local matters, and can do any light work, such as breaking stones, &c. Often

weeps because he is 'not like other boys,' and, if annoyed, exhibits great obstinacy, though as a rule he is peaceable. Mother healthy and non-goitrous; father was killed by a quarry accident, was non-goitrous, but had a brother with a 'thick neck,' and a sister with exophthalmic goitre. There are three brothers and one sister; the faces of all have a somewhat puffy and putty-like appearance, and sister suffers from bronchial 'asthma'; but all are non-goitrous. He is thick-set and somewhat deformed, and is about 4 feet 6 inches only in height.

Present condition.—*Head* appears too large for body; forehead depressed; occiput also very depressed; very high from ear to crown; two halves not quite symmetrical, but is somewhat conical, base down. *Hair*, short and thick; *eyebrows*, somewhat scanty. *Face*, large, puffy, without any expression. *Nose*, very thick, especially the alæ, which by their thickness almost close the nostrils. *Eyelids* are much swollen in morning, being sometimes like 'blebs.' *Lips* thick, and *mouth* large; but tongue, although large, is somewhat pointed, and not a typical cretin's tongue. *Lower jaw*, large and heavy. *Ears*, big, thick, and projecting. *Teeth*, wide apart, but pretty regular and not very carious (first tooth of primary dentition appeared when one year old). *Eyes*, wide apart and expressionless, but not squinting. *Neck*, although large, being wide from side to side, yet presents a remarkable depression between the sternomastoids and over the trachea. No thyroid can be made out; no supraclavicular tumours. *Thorax*, well developed. *Abdomen*, large and pendulous. *Pelvis*, narrow; *genitals*, fairly developed. *Limbs*, rather short and thin, large-jointed, and he walks with a swinging-from-side-to-side gait. *Hands* and *feet*, not very large, and normal. *Voice*, rather hoarse and grunting, but fairly distinct. *Sight* and *hearing*, good. *Muscles*, somewhat feeble. *Patella tendon reflex*, absent on both sides. *Cutaneous sensibility*, not much below par. *Respiration*, slow. Pulse under sixty. Is sufficiently intelligent to go errands, deliver messages, &c., and is fond of music. *Urine*, acid, s.g. 1.010; no albumen.

CASE III.

(First examined on December 6, 1884.)

History.—W— J—, male, aged twenty-seven years, was born in Rookhope, lived there one year, when his parents removed to Allenheads (where the drinking water is soft but contains iron; having passed through shale beds, which also causes it to become slightly bituminous, so that a 'thin scum' rises to the surface if a

quantity be left to stand overnight). Thirteen years ago he came to Stanhope. He was apparently 'all right' until he was seven years of age, when he had a very severe attack of measles, during which he was delirious and has since been deaf.

Present condition.—His head and face (which is very 'pasty' in hue) present the same characters as those of Case II., and his gait is similar, but more rolling; he is weaker in his body, and his limbs have not been known to swell. The condition of tongue, thorax, belly, pelvis, and genitals is like that of Case II.; in fact, the striking resemblance between the two youths, in every respect, had been noticed by the parents themselves. The only differences are that in Case III. the intelligence is higher: he takes an interest in local events as reported in the local papers, but does not like Parliamentary news. When asked to read he does so in a gruff, monotonous, and very hoarse voice, scarcely intelligible to the listener. He can also calculate mental arithmetic to a certain extent. He cannot work, and is, in mind and body, slowness personified. He was late in cutting his 'milk' teeth; permanent teeth somewhat carious. The *neck* is similar to that in Case II., but the hollow over the trachea is not so well marked, and the absence of the thyroid cannot be predicted with such certainty as in Case II. No supraclavicular tumours. Sight excellent. Father and mother, brothers and sister, are all healthy, non-goitrous, and intelligent.

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